THE EFFECTS OF COOPERATIVE AND COMPETITIVE LEARNING METHODS ON THE MATHEMATICS ACHIEVEMENT, ATTITUDES TO SCHOOL, SELF-CONCEPT AND FRIENDSHIP CHOICES OF MAORI, PAKEHA AND SAMOAN CHILDREN.

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ABSTRACT

This study examined the effects of cooperative and competitive learning methods on the mathematics achievement, attitudes to school, self-concept and friendship choices of Maori, Samoan and Pakeha children. Three hundred and nineteen children, aged seven to eleven, from fourteen classes in four racially-mixed urban primary schools participated in the three week intervention. After being randomly assigned to two conditions, stratifying for sex, ethnic membership and mathematics performance, the children worked cooperatively or competitively on an individualized mathematics programme. Significant gains in mathematics achievement were found for the sample as a whole. However, no overall effect for learning condition was present on any of the measures. A comparison of the scores of the different ethnic groups showed that Samoan children made the greatest improvement on word problems and scored the highest on the Cooperation, School Satisfaction, Penmanship/Neatness and Confidence subscales. On the sociometric measure, Maori children, and to a lesser extent, Samoan children in the cooperative condition made more cross-ethnic friendship choices than those in the competitive condition. The results of this study suggest the importance of further research on the use of group-oriented learning methods in the New Zealand multicultural classroom.

INTRODUCTION

Educational research, in the past, has commonly focussed on pupil characteristics such as home background, ability, or personality characteristics (Thomas, 1985, p.1) in searching for ways of improving academic achievement and attitudes to school. Recently, the focus of attention has moved onto situational factors, such as the teaching process itself (Thomas, 1985). Many researchers now believe that the "implicit curriculum" of the learning environment (Crockenberg & Bryant, 1978; Thomas, 1979) may have a strong influence on the way pupils interact with each other, on their attitudes to themselves and to school and on their subsequent level of achievement (Johnson & Johnson, 1978; Slavin, 1983; Thomas, 1978, 1979). It is suggested that cooperative, competitive and individualistic learning methods each have a different influence on the socialization process (Crockenberg & Bryant, 1978) and vary considerably in their suitability for children of different ethnic groups. It is most important, therefore, that an examination of the effects of different learning methods be an essential part of current educational research.

This introduction will be divided into four main sections. First, background research on cooperative and competitive behaviour will be discussed and general research on cooperative, competitive and individual learning methods will be reviewed. Second, cooperative and competitive learning approaches will be examined in the context of the

multicultural classroom in New Zealand. Relevant research will be discussed. Third, the rationale and methodology of the present research will be explained. Finally, hypotheses for this study will be proposed.

Background to research on cooperative, competitive and individualistic behaviour

Much research has been carried out to examine patterns of cooperative, competitive and individualistic behaviour. In general, researchers have used the same behavioural definitions in structuring their experiments. Under a competitive goal structure, if one pupil obtains a goal, the others are prevented from obtaining their goals. Under a cooperative structure all pupils experience the same outcome. When one pupil obtains a goal, all pupils obtain their goals. Under an individualized goal structure, pupil achievement is independent. The goal achievement of one pupil is unrelated to that of other pupils.

Cross-cultural studies, using experimental games to study cooperative, competitive and individualistic communication patterns in children found wide differences between children of traditional, transitional and Westernized communities. Children from traditional communities tended to cooperate during experimental games, whereas children from Westernized communities showed more competitive and individualistic behaviours (Kagan & Madsen, 1971, 1972; Knight & Kagan, 1977; Madsen, 1971; Shapira, 1976; Sommerlad & Bellingham, 1972; Thomas, 1975).

General research on cooperative and competitive learning methods

Experimental game studies led to an increasing awareness that competitive or individualized teaching strategies may not be appropriate for all children. As a result, several independent groups of researchers began to develop (in the 1970's) a variety of cooperative instructional methods which required pupils to work in small (usually heterogeneous) groups for the purpose of helping each other learn. A number of United States studies tested these methods with under-achieving or minority group children, in ethnically mixed classes and in classes in which intellectually or physically handicapped children have been mainstreamed. In general, it was found that children participating in these programmes showed improvement in academic achievement (Johnson & Johnson, 1975; Slavin & Karweit, 1981) in attitudes towards school and other children (Johnson & Johnson, 1978; Johnson, Johnson & Anderson, 1976) and in self-concept (Blaney, Stephan, Rosenfield, Aronson & Sikes, 1977), when compared to those using individual, competitive or traditional whole group learning methods. However, not all approaches affected achievement, attitudes and self-concept in the same way. It is necessary, therefore, to examine the various cooperative methods used and to study their effects on the different variables.

Types of cooperative learning methods

Each of the cooperative learning strategies consisted of two main components, a cooperative task structure and a

cooperative reward structure. However, the forms of these structures differ across methods. The methods known as the Student Teams-Achievement Divisions (STAD), developed by Slavin (1978), and Team-Assisted-Individualized (TAI), designed by Slavin, Leavey and Madden (1984) use group study (with no task specialization) and group reward for individual learning. The groups are designed so that each student must do a share of the work and learn the material in order to improve the team score by contributing his or her own score based on individual improvement over past performance. TAI combines cooperative learning with individualized instruction. The Teams-Games-Tournament (TGT) procedure (Slavin & DeVries, 1979) is similar to that used in the above, but games against other teams are used instead of tests to add points to team scores. Jigsaw, developed by Aronson, Blaney, Stephan, Sikes and Snapp (1978) is a method involving task specialization with individual reward, whereas Jigsaw II (Slavin, 1978) involves task specialization with group reward for individual learning. "Learning Together" (Johnson & Johnson, 1975, 1978) and Group-Investigation (Sharan & Sharan, 1976) involve group study with group reward for group product.

Cooperative learning and mathematics achievement

A number of reviews have focussed on studies examining the effects of cooperative learning on achievement (e.g. Johnson & Johnson, 1974; Johnson, Maruyama, Johnson, Nelson & Skon, 1981; Michaels, 1977; Sharan, 1980; Slavin, 1977, 1980, 1983). However, no consistent conclusions have been reached about the effectiveness of such methods on increasing

achievement, as the studies have used a variety of task structures, settings and outcome measures. Slavin (1983) focussed more specifically on the incentive structures and task structures used in learning research. He found that the majority of STAD, TGT, TAI and Jigsaw II studies (all of which use group study with group reward for individual learning) found cooperative learning methods more effective than either competitive or individual methods in increasing levels of student achievement (e.g. Slavin & Karweit, 1981; Slavin, Leavey & Madden, 1984; Ziegler, 1981). Slavin concluded, therefore, that cooperative learning methods only have a positive effect on achievement if the group members are given clear incentives for doing well as a group and if rewards are dependent on individual learning performance (p.44). Studies of the interactions between cooperative learning and ethnicity found that minority students learning cooperatively (using a modified STAD method) gained more than non-minority students, when compared to those learning individually (Lucker, Rosenfield, Sikes & Aronson, 1978; Slavin & Oickle, 1981).

Cooperative learning and attitudes

All types of cooperative learning methods have consistently shown positive effects on affective variables. Improvement has been found in liking for school (Blaney et al., 1977; Slavin & Karweit, 1981) and in enjoyment of learning tasks (Garibaldi, 1979; Humphreys, Johnson & Johnson, 1982; Slavin, Leavey & Madden, 1984). An analysis of relationships between scales measuring attitudes to

cooperation and competition and scales measuring attitudes to school (Johnson & Ahlgren, 1976) found that cooperativeness was consistently related to a broad range of positive attitudes towards schooling.

Cooperative learning and self-concept

Several studies of small group learning found that cooperative methods had positive effects on self-esteem. The technique which focuses directly on improvement in self-esteem is Jigsaw (Blaney et al., 1977) in which each member "teaches" the group one aspect of the topic being studied. Teams-Games-Tournament (TGT) and Student Teams Achievement Divisions (STAD) (Madden & Slavin, 1983; Slavin & Karweit, 1979), both of which require a contribution from all group members, have also been found more effective in improving self-esteem than traditional whole class methods. One of the two studies evaluating Team-Assisted-Individualization (TAI) and Individualized Instruction (II) (Slavin, Leavey & Madden, 1984) found that children in both the TAI and II groups showed a significant increase over time in self-concept in maths, compared to the control group which decreased.

Cooperative learning and cross-ethnic friendship choices

Studies of the effects of cooperative and competitive learning methods on cross-ethnic friendship choices have been based on the principle that cooperative contact between members of different ethnic groups increases their liking for one another (Allport, 1954). Most of the studies which used Jigsaw, STAD, TGT and Learning Together methods found more cross-ethnic friendship choices were made by children in the

cooperative condition than those in competitive or individual conditions (DeVries, Edwards & Slavin, 1978; Slavin, 1979; Warring, Johnson, Maruyama & Johnson, 1985; Ziegler, 1981). However, results of the few studies which examined the effects of the cooperative and individual learning methods on different ethnic groups have been inconsistent even when researchers used the same type of method. Weigel, Wiser and Cook (1975) and Slavin and Oickle (1981) found an effect for white students only under the cooperative learning condition, whereas Slavin (1979) and Ziegler (1981) found no race x treatment interactions at all. Research by Weigel et al. (1975), however, showed that members of the students' own ethnic group were overrepresented in friendship choices made and Slavin (1979) found that blacks named more whites as friends, than vice versa, regardless of treatment.

Learning in the New Zealand multi-cultural classroom

The studies described above provide strong support for the introduction of cooperative learning into ethnically mixed classrooms. Research in the United States as shown that this approach has many benefits for academic achievement, and attitudes towards self, school and other children. However much more research needs to be done in New Zealand schools to see whether Polynesian and Pakeha children respond to group-oriented learning methods in a similar manner.

Frequently, statistics are reported on the low rates of Maori scholastic achievement, thus reinforcing existing negative stereotypes. Maori children are seen as culturally deprived or regarded as the "problem in education" (Penfold,

in Thorsen, 1987; Simon, 1986; Walker, 1980, 1984). However, studies have shown little evidence of differences in the cognitive abilities and styles of Maori and Pakeha children (Chapman, 1973, in Harker, 1981; Harker, 1977). Many are now suggesting that the way children are taught may need to be examined (Bray, 1980; Harker, 1980; Department of Education, 1980; Hunkin, 1985; Thomas, 1979). There is a growing awareness that the classroom environment in many New Zealand schools is ill-adapted to the particular needs of Maori and Polynesian children (N.Z. Vocational Training Council, 1975; McKessar & Thomas, 1978; Pere, 1982; Pitt & Macpherson, 1974) and that children are taught from a Pakeha perspective (Tauroa, 1982; Thorsen, 1987; Smith, 1981). Competitive and individualistic behaviour has often been emphasized to the disadvantage of Polynesian pupils (Thomas, 1975, 1979). Their helping behaviour has commonly been interpreted as disruptive (Thomas, 1979) or regarded as "cheating" (Graves & Graves, 1984). Even though many primary schools now place more emphasis on group work (Scott, 1986), learning styles still tend to be those which suit the monocultural Pakeha classroom (Hunkin, 1985), especially as children move onto the higher classes (Scott, 1986).

An attempt has been made to make schooling more appropriate for the Maori pupil by the introduction of *Taha Maori* (the Maori dimension) into the curriculum. However many believe that *Taha Maori* needs to be lived, not just fitted in as another subject (Smith, 1986; Tauroa, 1982). It is suggested by some that unless the structures of schooling are

changed, the introduction of *Taha Maori* will have little effect (Harker, 1987; Thorsen, 1987).

In order to determine the type of structure which would be appropriate for Maori and other Polynesian pupils it may be helpful to look at the findings of ethnographic studies and psychological research. Ethnographic studies of a number of Polynesian groups, including New Zealand Maoris and Samoans (Graves & Graves, 1984; Pitt & Macpherson, 1974; Ritchie, 1963) suggest the presence of a high degree of cooperative social behaviours among the people of these cultures. When individuals strive for achievement, it is within the context of intergroup competition. They work for the common good, rather than for personal aggrandisement (Graves & Graves, 1984; Ngan-Woo, 1985; Pere, 1982; Pitt & Macpherson, 1974; Thomas, 1978).

A study by Graves and Graves (1974) involving observation of the behaviour of New Zealand preschool and primary school children (aged 2 to 11) found that the Polynesian style of interaction was more commonly "inclusive" whereas the Pakeha style of interaction tended to be "exclusive". "Inclusive" was used to describe behaviour which encouraged a sense of belonging among persons in a group. Those engaging in "exclusive" style of interaction tended to prefer individual activities in the presence of others or one-to-one relationships (Graves & Graves, 1974).

Patterns of cooperative and competitive behaviour among Polynesian and European children were examined by Thomas (1975, 1978) using experimental games. He found that rural

New Zealand Maori children showed more cooperative behaviour on the Madsen Cooperation Board, than European and urban Maori children. In a later study, Thomas (1978) found that Samoan children showed high levels of cooperation (75%) in comparison to urban European New Zealand children (12%). These findings were consistent with patterns found in other cross-cultural studies mentioned earlier.

The results of the above research led Graves and Graves (1974) and Thomas (1978, 1979) to suggest that the increased use of group-oriented teaching approaches may benefit Polynesian children, who could use their social talents in group problem solving. Similarly, Pakeha children, whose maladaptive competitiveness in game experiments may indicate the presence of a "cooperation deficit" (Thomas, 1978, 1979), would also benefit.

Research on cooperative learning methods in the New Zealand setting

Despite the support for cooperative learning methods provided by Thomas' experimental games studies and by overseas research on the benefits of group-oriented learning, only a few have investigated the effects of these methods in New Zealand schools. The major studies in this area have also been carried out by Thomas (1985), though Hunkin (1985) and Chalip and Chalip (1978) have made some contribution to research on learning approaches.

Two year-long studies were conducted by Thomas (1985) in both rural and urban schools to investigate the effects of group-oriented teaching techniques on the behaviour, liking

for school, self-esteem, mathematics and language achievement and friendship choices of Standard Three, Four and Form I Maori and Pakeha children. Eight classes, each composed of at least 20% Maori children, participated in the first study. Classes using group-oriented teaching techniques showed marked increases in the rate of cooperative behaviour and children showed significantly greater gains in language test scores compared to control classes. There were no significant effects for teaching group or ethnicity on any of the other measures. Thomas' second study, conducted with twelve classes, produced similar results on the language, self-esteem and popularity measures. However, unlike the earlier study, children experiencing group-oriented techniques showed significantly greater gains on mathematics and were less likely to show an extreme dislike for school (Thomas, 1985).

A small study carried out by Chalip and Chalip (1978) found that children who experienced a combination of cooperative and individual approaches made significantly fewer errors on a Noun and Verb Identification Test than those experiencing either one of the two approaches separately. Learning condition, however, had no effect on interpersonal attraction.

Strategies used by "successful" teachers in eight urban multicultural New Zealand classrooms were examined by Hunkin (1985). He concluded that cooperative goal structures, especially those with group rewards focussing on task completion or mastery, are the most appropriate ones to use in multicultural classrooms. In the classes observed, children

were involved in cooperative activities, as much as possible, and were encouraged to seek help from their peers as well as from their teachers (p.6).

Related New Zealand research on school attitude, self-concept and friendship choices

Very little research has been done in this country on the school attitudes, self concept or friendship choices of Maori and Samoan children.

A longitudinal study of early school leavers at two rural and two urban secondary schools (Olsen, 1972, in Harker, 1980) found that Maori pupils were three times more likely than Pakeha pupils to be early leavers, regardless of their level of ability. While studying the effects of learning techniques, Thomas (1985) reported that, as the school year progressed, Maori children overall showed a greater decrease in liking for school compared to Pakeha children.

Anthropological accounts (Pitt & Macpherson, 1974), and a study of Samoan parents and the primary school (Fairbairn-Dunlop, 1981) suggest that Samoan children in general, have favourable attitudes towards school and that their parents place a great deal of importance on the value of education.

Research on the self-concept of Maori children has produced conflicting results. According to Ranby's much publicized (1974) study of a large sample of Maori and Pakeha secondary school pupils, the mean general self-concept of Maoris was lower than that of Pakehas. This was the case even when controlling for such factors as family size, socio-economic status, age, class at school, place of residence and

level of academic achievement. Chapman (1984), however, questions the validity of some of the procedures used by Ranby in analysing the results and suggests that Ranby's conclusions are suspect. Also (as Ranby himself pointed out), the measures used may have lacked cultural equivalence. Maori and Pakeha self-concept may vary according to the different emphasis placed on the importance of *whakaiti* (being humble) and *whakahihi* (setting oneself above others) (Chapman, 1984). When focussing specifically on self-perception of academic ability, in a study of Form 1 pupils, Chapman (1984) found no significant difference between Maori and Pakeha academic self-concepts. These findings were supported by the two studies of Standard Three, Four and Form 1 Maori and Pakeha children conducted by Thomas (1985). He discovered no significant differences between the Maori and Pakeha samples on the mean score for self-esteem.

Observations of people of Samoan descent (Hunkin, 1985; N.Z. Vocational Training Council, 1975) suggest that their feeling of self-worth is very closely related to their individual contribution to the social standing of their whole *aiga* (family). Family (rather than personal) pride provides the motivation for children to do well at school.

New Zealand studies, examining the friendship choices of primary and early secondary Polynesian and Pakeha children, found few differences between ethnic groups (Edgerley, 1972; Morrison, 1978; Thomas, 1985; Young, 1977). However Morrison (1978) found that the number of own race friendship choices was significantly higher than would be expected from the

distribution of racial membership in the schools. An increase in same-ethnic friendship choices as children grew older was found by Morrison (1978) and (for Maori children) by Edgerley (1972).

Rationale

Until recently, the low achievement levels of Maori pupils were mainly attributed to person-centred factors. However, many are now suggesting that situational variables such as the teaching approaches used may be at fault.

The research discussed in this review presents a strong case for the increased use of the cooperative learning approach. However, more studies are needed to examine the effects of group-oriented learning techniques on the achievement, attitudes and interpersonal relationships of Maori, Pakeha and Pacific Island children in New Zealand classrooms.

Methodology and Rationale for Methodology

The methodology used in this research was a variation of Team-Assisted-Individualization (TAI) (Slavin, 1978; Slavin, Leavey & Madden, 1984). In the present study, a cooperative reward structure was compared to a competitive reward structure. The cooperative learning method used was group study (no task specialization) with group reward for individual learning. This method was chosen because, of 27 such studies reviewed by Slavin (1983), 24 (89%) found positive effects on student achievement. Many also found that the use of this method contributed to increased self-esteem and improved attitudes to classmates and schoolwork. Studies

testing other methods of cooperative learning showed fewer positive effects on achievement but had similar social benefits.

Mathematics was the subject area studied during the research period. This subject was chosen because at the time of the present study it was still taught quite formally in many middle primary and intermediate school classrooms. Most of the children chosen for the intervention would have experienced both the small group methods used in the Junior School and more individualistic and/or competitive methods as they grew older.

Even though teachers may be instructed to cover certain concepts in their mathematics lessons, variations may occur in the material covered. Therefore, an individualized programme was chosen for this study to ensure uniformity of subject material for pupils in all classes. This type of programme was also considered the most appropriate for Polynesian children who appear to learn best using structured activities which have clear aims and definite skills to be mastered (Fairbairn-Dunlop, 1981; Hunkin, 1985). Hunkin's classroom observations led him to suggest that children from lower socio-economic groups may also benefit from such structured programmes.

Some of the previous studies of cooperative and competitive (or individual) learning compared small learning groups, in one condition, with one large group, in the other (Humphreys, Johnson & Johnson, 1982; Slavin & Karweit, 1981; Weigel et al., 1975) thus confounding the group variable. In

other studies only the children in the cooperative group were rewarded (Slavin, 1979; Slavin et al., 1984, 1984b; Weigel et al., 1975). In the present study, children in both conditions worked in small groups and an equivalent amount of reward was allocated to each condition.

Children in the present study were categorized according to their ethnic self-identity. They were asked whether they were Maori, Samoan, Pakeha, or of another ethnic group, and asked to tick an appropriate box on the front page of the first measure (see Appendix Two, Mathematics Test 1). As this procedure restricts choices by assuming that each person belongs to only one ethnic group (Thomas, 1988, p.61), children were permitted to tick more than one box. This resulted in the additional categories: Maori/Pakeha and Samoan/Pakeha.

As Thomas (1988) pointed out, identification with a particular ethnic group does not necessarily mean familiarity with the culture of that ethnic group. Therefore, the Maori or Samoan children in the present study may vary in the degree to which they are familiar with the lifestyle of the culture with which they identify. However, as no measures of knowledge of the Maori or Samoan cultures were taken, comparisons in this study are merely made between children who identify themselves as members of a particular ethnic group.

Aim and Hypotheses

This study was designed to investigate the effects of cooperative and competitive learning method on the mathematics achievement, attitudes to school, self-concept and friendship

choices of Maori, Samoan and Pakeha children.

The major hypotheses of this study were as follows:

1. The cooperative learning situation, compared to the competitive learning situation, would promote greater improvement in mathematics.
2. The cooperative learning situation, compared to the competitive learning situation, would promote more positive attitudes to school, a higher self-concept and more cross-ethnic friendship choices.
3. The Samoan children and, to a lesser extent, the Maori children would benefit from the cooperative learning experience (on learning, attitudinal and self-concept variables) more than the Pakeha children.

In addition to these hypotheses, the proportion of friendship choices made by children of the different ethnic groups were to be examined in relation to the proportion of those ethnic groups in the sample.

METHOD

This study compared the effects of cooperative and competitive learning methods on the mathematics achievement, attitudes to school, academic self-concept and friendship choices of Maori, Pakeha and Samoan children. Children in both cooperative and competitive learning conditions worked, in small groups, on the same individualized mathematics programme for one hour per day, over a period of three weeks. Differences in mathematics achievement were measured by a pretest and a post-test. On the other three variables, comparisons were made using post-experimental measures only.

Participants

Subjects: The initial sample was composed of 376 children (169 boys and 207 girls) from fourteen complete classes in four racially mixed urban Christchurch primary schools. Five children who were mainstreamed were withdrawn from classes each day during the research period. Teachers volunteered to participate in the study in response to a request from their school principals who had been provided with details of the research by the experimenter.

The final sample consisted of 319 children who identified themselves as either Maori (72), Pakeha (200) or Samoan (47). Seventeen were in Standard 1, 73 in Standard 2, 85 in Standard 3 and 144 in Standard 4. Their ages ranged from seven to eleven years. All were from lower socio-economic groups (levels 4-6 of the 1981 Elley-Irving socio-economic index). Children who considered themselves of mixed ethnic origin (33)

or of another ethnic group (17), or children from a higher socio-economic group (7) were not included in the analysis. Of the sample analysed, 152 children were in the competitive condition and 167 in the cooperative condition.

Teachers: The majority of the teachers who took part in the study had a number of years' teaching experience. Of the fourteen teachers, eight were female and six were male, twelve were Pakeha and two were Samoan.

The teachers varied in the extent to which they usually used cooperative, competitive, or individual teaching methods during mathematics. Three teachers encouraged their children to work individually, seven teachers used a combination of the above methods and four teachers used mainly cooperative learning techniques.

Measures

Mathematics Achievement Tests

These curriculum specific tests consisted of two parallel forms used as a multiplication pretest and post-test (see Appendix One). The results of a pilot study with 80 pupils showed that the two forms were equivalent. The tests were an extended and adapted version of a pretest designed by Eleanor Burt (Gilberthorpe School) and Barry Brooker (Canterbury Education Board Mathematics Adviser). Both tests consisted of 40 multiplication items, with three algorithms and one word problem at each of ten different levels of difficulty. The items of each level of the test corresponded to the concepts covered in each unit of the individualized multiplication programme used in the study.

The tests were used to compare the effects of cooperative and competitive learning methods on the mathematics achievement of children of the different ethnic groups. They also served as a diagnostic tool, so that children could be placed at an appropriate level in the individualized programme.

Internal consistency (α) for the multiplication achievement tests was .94 and .95.

School Attitude Survey

This measure (see Appendix Two) was adapted from the Minnesota School Attitude Survey (Ahlgren, 1983), a revised version of the Minnesota School Affect Assessment, suitable for use with six- to eleven-year old children.

The School Attitude Survey was designed to assess children's attitudes to school, after they had participated in the cooperative and competitive learning interventions. It consists of three subscales: General School Attitude (28 items), Competition (3 items) and Cooperation (3 items). Two different types of item format are used and possible response scores for individual items range from 0 to 3.[1]

The survey, as a whole, contains items relating to basic subjects, student role, other students, academic support, acceptance, academic pressure, personal worth, competition and cooperation.[2] Items were selected directly from the Minnesota School Attitude Survey. A few items were modified so that they would be idiomatically appropriate for use with New Zealand school children.[3] In addition, four members of the Samoan and Maori communities were consulted before the

administration of the School Attitude Survey and the Student's Perception of Ability Scale to ensure that the questionnaires were conceptually equivalent for Maori, Samoan and Pakeha pupils.

An estimate of the internal reliability of the School Attitude Survey, for the sample in this study, was determined from Cronbach's coefficient alpha. The alpha value for the General School Attitude subscale was .80. The coefficient alpha for the Competition subscale was .68 and for the Cooperation subscale .47.

Student's Perception of Ability Scale (SPAS)

This scale (see Appendix Three) was used after the intervention to assess the academic self-concept of children in the cooperative and competitive learning conditions.

The Student's Perception of Ability Scale, developed by Boersma and Chapman (1977), consists of six subscales derived through factor analysis: Perception of General Ability, Perception of Arithmetic Ability, General School Satisfaction, Perception of Reading and Spelling Ability, Perception of Penmanship and neatness (each of which contain 12 items) and Confidence in Academic Ability (10 items). The Full Scale contains 70 forced-choice "Yes-No" items.

Chapman, who collected the New Zealand psychometric data for the Student's Perception of Ability Scale (Chapman & Boersma, 1983) made some minor changes to the wording of some items to make them more appropriate for New Zealand school children. These changes were retained in the present study and other minor wording changes introduced.[4]

Estimates of internal consistency for a New Zealand sample were found to be virtually identical to that of a Canadian sample (Chapman & Boersma, 1983). For the SPAS Full Scale, Cronbach's coefficient alpha was .915, whereas the subscale alphas ranged from .686 (Confidence) to .855 (Reading/Spelling). The alpha value for the Arithmetic subscale was .837.

Sociometric Measure

The sociometric measure was administered at the end of the learning intervention for the purpose of comparing the number of cross-ethnic friendship choices made by children in the different learning conditions and ethnic groups. It was based on a measure used by Thomas (1983) and consisted of a list of names of all the children in a particular class. In the present study, subjects were asked to place a tick by the names of six children, under the heading "Be my best friend".[5] The advantage of using Thomas's checklist procedure was that children did not have to spend time trying to spell their friends' names.

Administration of tests and questionnaires

Teachers were advised of appropriate days and times for administering the tests and questionnaires. To avoid fatigue, no more than two testing sessions were to take place on a single day. Items of the Student's Perception of Ability Scale and the School Attitude Survey were read aloud to minimize possible confounding effects due to difficulty in reading. In order to reduce the chances of children's responses being biased in a socially desirable direction,

emphasis was placed on the confidentiality and anonymity of responses.

For further details of the measurement procedures, see Appendix Four, Teacher Guidelines, pp.2-3 and Appendix Five Instructions for Administering the Tests and Questionnaires.

With the exception of the sociometric measure which took 10-15 minutes, administration of each of the tests and questionnaires took between 30 and 75 minutes.

Procedure

Teacher Preparation

Before participating in the study, the teachers attended two meetings which together totalled approximately three hours. These took place in the teachers' own staffrooms three weeks and one week before the mathematics pretest.

During the meetings, teachers were provided with details of the experimental procedures. They were encouraged to comment on the curriculum materials and measures to be used and asked to supply relevant information about their classes.

At the beginning of the intervention, teachers were visited each day until the procedures were established. As some teachers had difficulty with the scoring cards, regular class visits were continued every day or every second day for the entire research period, to ensure that teachers had all the assistance they needed.

Learning conditions and groups

Each class was divided into two learning conditions, cooperative and competitive, to control for teacher effects. The composition of each condition was similar with respect to

mathematics ability, sex and ethnic group. Children within each condition were then divided into small groups or clusters of approximately four children.

The method of assignment to groups and conditions was as follows:

(1) Within each class, boy's and girls' mathematics tests were ranked separately according to scores.

(2) Boys and girls were then alternately assigned to either the cooperative or the competitive conditions.

(3) Some children, of the same sex and mathematics score, were swapped from one condition to the other to ensure equal distribution of ethnic groups in both conditions.

(4) Finally, children within each condition were divided into clusters of four (or three or five), with children of different sex and ethnic group evenly distributed among the clusters.

Children in the competitive and cooperative learning conditions were given different instructions.

Children in the competitive condition were to try to obtain a higher score than other members of their cluster. They were encouraged to work as much as possible on their own, but they could ask the teacher for help if necessary. No specific instructions were given about helping group members. At the end of each lesson, children with first and second highest scores in each cluster received recognition on a scoring card. (For more detail of the scoring procedure see section titled Scoring and Recognition, p.34).

Some of the instructions for children in the cooperative condition were based on rules suggested by Burns (1981). Although the children worked on individual worksheets, they were to help other members of their cluster if asked. If they had any difficulty with their own work, they were to ask someone else in their own cluster for help. They were to obtain assistance from the teacher only if

(a) no-one in their cluster could help.

(b) their individual scores did not meet the criterion required for them to continue the maths exercises.

(c) the teacher offered to give a short lesson to children working on the same concepts.

It was explained to children in the cooperative condition that their goal was to help their cluster earn a group score which met the criterion set for their cluster that day. Each child in a cooperative cluster which met the predetermined criterion received recognition on a scoring card.

Description of Materials

An individualized mathematics programme was used during the learning intervention to ensure uniformity of learning materials among classes. The mathematics programme consisted of ten colour-coded units based on the ten steps of the cyclic approach (see Appendix One) designed by Eleanor Burt (Gilberthorpe School) and recommended by Barry Brooker, the Canterbury Education Board Mathematics Adviser. Each unit of the individualized programme included a number of sets of exercises and answer sheets, checkouts (10-item tests to follow each set) and checkout answers. These materials were

kept in boxes easily accessible to the children, who selected their own materials throughout the lesson. Each child kept completed work (with the exception of checkout answers) in a large envelope, on which was pasted a progress chart to be coloured in each time a unit was completed.

Each teacher was provided with a summary of objectives and concepts to be taught in the multiplication units (see Appendix Six). References to teaching notes in text handbooks were given on each page of the multiplication units.

Conference charts were prepared by the teachers for recording the names of children who received individual instruction. Stars and scoring cards were used to provide recognition of the children's effort and achievement while working in groups on the individualized mathematics units (see Appendix Four, Teachers Guidelines, p.9).

Preparation of the individualized mathematics programme

The individualized mathematics units were prepared by the experimenter (a trained teacher) in consultation with Barry Brooker, the Canterbury Education Board Mathematics Adviser. Materials for the units were selected from School Mathematics Books Two and Three and their corresponding supplements, from Modern School Mathematics Books Four, Six and Seven and Signposts to Success. Additional word problems were composed to complete the units. Checkouts for each Set within a mathematics unit were also designed by the experimenter. Two pupils (aged 9 and 11), of average mathematics ability, tested several units during the preparation stages, to ensure that they were of a length that could be completed

during a single maths lesson.

When the units were completed, sufficient copies (an estimate) were printed for each child in the study to have an individual copy to work from at an appropriate level. After the mathematics pretest had been marked, children were assigned to the appropriate step in the individualized programme and additional copies of units made.

Pupil preparation and familiarization with materials and procedures

On the first day of the research period, the teachers explained to their pupils that they would be working differently during their maths lesson over the following few weeks. The pupils were shown the multiplication units and their use was explained to them. Children were then assigned to the competitive and cooperative conditions and instructed separately about methods of working and scoring within their clusters. Finally, an opportunity was given for the children to practise using the materials.

Procedure for use of multiplication units

During the maths lesson each day, the children sat with other members of their cluster. They worked on one of the Sets within the multiplication units, following the rules for cooperative or competitive learning (see section titled "Learning Conditions and Groups", p.28). Exercises in each Set were either circled or uncircled. The children began by answering all circled items. When they completed this task, they went to the box, found the appropriate answer sheet and marked their own work. If there was anything they did not

understand, they were to seek help. The children then returned the Set and answer sheet and collected the appropriate checkout.

The checkouts were to be completed without any assistance from anyone. When finished, the checkout answer sheets were collected and work marked by another child in the same cluster. The score (number right and number completed) were recorded on the cluster scoring card and checkout answer sheet returned.

The minimum criterion for progressing to the next Set was (80%) $(\frac{8}{10})$ correct on a checkout. If children scored below 80%, they made an appointment to see the teacher by writing their names on a conference chart, collected the same Set again and began answering the uncircled items while waiting for a conference. If the children still scored below 80% after a second attempt at the checkout, they proceeded to the next Set, regardless of the fact that they did not meet the criterion. Those children who scored 80% or higher on a checkout were to begin working on circled items of the next Set. See Appendix Two, Teacher Guidelines, p.6 for a diagrammatic representation of the procedure described above.

If a number of children from either condition needed explanation or clarification of the same concepts, they were to be brought together for a 5-10 minute session with the teacher. In actual fact, this rarely happened during the study, as teachers were busy helping children mark checkouts or having conferences with individuals.

Scoring and Recognition

Cooperative clusters: At the end of each checkout, children wrote (in pencil) their own score on the sheet on the back of their group scoring card. If they completed a second checkout in the same lesson, this score was adjusted to include the second score. At the end of the lesson the children's scores were totalled and averaged to give a group scores, which was then written on the front of the card.

Each child in a cooperative cluster which scored above the pre-determined criterion received a star next to his/her name on the scoring card. The criterion group score for the cooperative clusters was initially set at 18. This was then raised or lowered by teachers (or experimenter), depending upon the performance of each cluster.

After the scoring cards had been checked by the teacher at the end of each lesson, the sheets of paper on the back were torn off and placed in an envelope. The next day, members of the cooperative cluster would see only the group score on the card. In this way, individual performance was de-emphasized and children encouraged to identify with the group as a whole.

Competitive clusters: Upon the completion of each checkout, the children wrote their individual scores on the front of their cluster scoring card in pencil, so that a second checkout score, obtained during the same lesson, could be added onto the first score. No group score was calculated. At the end of each lesson, individual scores were ranked. No criterion had to be met. Instead, 1st and 2nd placegetters in

each of the competitive clusters received a star by their name on the scoring card.

Approximately the same number of stars were awarded to each condition during the period of a week. If more stars were being earned daily by those in the cooperative condition, then 1st and 2nd placegetters in the competitive condition overall were also rewarded a star to even the numbers out.

For examples of the scoring cards see Appendix Four (Teachers' Guidelines, p.9).

Implementation Checks

Each class was visited by the experimenter every day or every second day to ensure that procedures were being correctly carried out. Although time did not always allow visits to take place during the actual mathematics lesson, a chat with teachers, together with the checking of scoring cards, gave a good indication of how well procedures were being implemented.

It was found that, for the majority of teachers, it was three to five days before the programme was running smoothly in their classes. Therefore, the actual duration of the learning intervention, when procedures were being correctly implemented, was 10-12 days.

RESULTS

The basic design of the study was a 3 (Maori vs Pakeha vs Samoan) × 2 (cooperative vs competitive) × 2 (test), with the first and second variables being between-subject factors and the third variable a within-subjects factor. Where only one (post) experimental questionnaire was administered, the design was a 3 (Maori vs Pakeha vs Samoan) × 2 (cooperative vs competitive).

The results of this study will be presented as follows. Firstly, the results of the mathematics achievement test, analysed by a multivariate analysis of variance, will be discussed. Then the results of the analysis of variance performed on data from the School Attitude Survey and Student's Perception of Ability Scale will be reported. Finally, the results of the sociometric measure, analysed by both a chi-square and a test for the significance of difference between two proportions will be presented.[6]

Mathematics Achievement Test

The first hypothesis was that the cooperative learning situation, compared to the competitive learning situation, would promote greater improvement in mathematics. In order to test this prediction, a 3 (ethnic group) × 2 (learning condition) × 2 (test) multivariate analysis of variance (MANOVA) was performed. (See Appendix Seven.) The results of this analysis are shown in Table 1. Main effects indicated that the sample as a whole showed a significant difference between pretest (M=11.66) and post-test scores (M=15.08), $F(1,301) = 108.51$, $p<.01$. There were, however, no significant

ethnic group differences, $F(2,301) = 1.32$, n.s. The first hypothesis was not supported as there was no significant test × condition interaction, $F(1,301) = .58$, n.s.

Table 1.

Mean Scores for the Mathematics Achievement Test by Condition and Ethnic Group

Condition and Ethnic Group	Pre-test	Post-test
Competitive		
Maori (N=32)	12.13	15.25
Pakeha (N=92)	12.08	15.09
Samoan (N=22)	10.77	14.14
Total Sample (N=146)	11.66	14.82
Cooperative		
Maori (N=36)	11.22	14.67
Pakeha (N=102)	13.24	15.92
Samoan (N=23)	10.52	15.39
Total Sample (N=161)	11.66	15.33

The third hypothesis was that the Samoan children, and to a lesser extent, the Maori children would benefit from the cooperative learning experience more than the Pakeha children. As indicated by the mean scores in Table 1, the interaction between ethnic group, learning condition and test was not significant, $F(2,301) = .69$, n.s.. Therefore, the third hypothesis was not confirmed.

Additional analyses were performed on algorithms and word problems separately. (See Appendix Eight and Nine for tables of these results.) On word problems, the ethnicity × test

interaction was significant $F(2,301) = 2.95$, $p<.05$. The mean scores indicate that the Samoan children (Pre-test, $M=2.18$; Post-test, $M=3.49$) showed the most improvement, the Maori children (Pretest, $M=2.38$; Post-test, $M=3.58$) showed intermediate improvement, and the Pakeha children (Pretest, $M=2.81$; Post-test, $M=3.55$) the least improvement on the word problem items of the multiplication test. No significant interaction effects were found for algorithms.

School Attitude Survey

Mean scores for the General School Attitude, Cooperation and Competition scales are shown, for each condition and ethnic group, in Table 2.

An analysis of variance (see Appendix Seven) showed no significant differences between the scores of children in the cooperative and competitive learning conditions, for either General School Attitude, $F(1,283) = 2.77$, n.s., or Cooperation, $F(1,299) = 1.14$, n.s., or Competition, $F(1,297)=.13$, n.s.. Therefore, the second hypothesis that the cooperative learning situation compared to the competitive learning situation, would promote more positive attitudes to school, was not supported.

No significant ethnic group differences were found on the General School Attitude, $F(2,283) = .99$, n.s. or Competition, $F(2,297) = .23$, n.s. scales. However, there was a main effect for ethnicity on the Cooperation scale, $F(2,299) = 5.97$, $p<.01$. Mean scores show that the Samoan children had the most positive attitude to cooperation ($M=7.40$) and the Pakeha children, the least positive attitude ($M=6.19$). The Maori

children scored in between the two groups (M=6.51) It should be pointed out, however, that the internal reliability for this scale was low (α.47) and differences may not be as marked as they seem.

Table 2.

Mean Scores for the School Attitude Survey by Condition and Ethnic Group

Competitive Condition Scale	Ethnic Group			
	Maori (N=34)	Pakeha (N=86)	Samoan (N=23)	Total Sample (N=143)
General School Attitude	51.64	53.96	55.95	53.85
Competition	4.37	4.56	5.17	4.70
Cooperation	6.34	6.09	7.17	6.53
Cooperative Condition Scale	**Ethnic Group**			
	Maori (N=35)	Pakeha (N=99)	Samoan (N=22)	Total Sample (N=156)
General School Attitude	53.36	51.30	53.14	52.60
Competition	4.54	4.49	4.41	4.48
Cooperation	6.68	6.28	7.64	6.87

Note. Higher scores indicate more positive attitudes.

The third hypothesis was that Samoan children and, to a lesser extent, Maori children would benefit more from the

cooperative learning experience (on attitudinal variables) than the Pakeha children. However, no significant interaction between ethnic group and learning condition was found for the General School Attitude, $F(2,283) = 1.69$, n.s., Cooperation, $F(2,299) = .09$, n.s., or Competition, $F(2,297) = .42$, n.s., scales.

Student's Perception of Ability Scale (SPAS)

A two-way analysis of variance was performed to examine data from this scale. (See Appendix Seven.) As indicated by the mean scores shown in Table 3, there was no evidence to support the second hypothesis that the cooperative learning situation, compared to the competitive learning situation, would promote a higher academic self-concept. There was no significant main effect for learning condition for either the Full Scale, $F(1,303) = .008$, n.s., or for any of the subscales.

Significant main effects for ethnic group were observed for the School Satisfaction, $F(2,295) = 9.67$, $p<.001$, and Penmanship/Neatness, $F(2,292) = 3.70$, $p<.05$, subscales. The Samoan children ($M=10.00$ and $M=8.96$) had the highest mean scores on these subscales and Pakeha children ($M=8.25$ and $M=7.72$) the lowest. The Maori children ($M=8.70$ and $M=8.39$) scored in between the two groups. A significant main effect for ethnic group was also found on the Confidence subscale, with both the Samoan children ($M=5.23$) and the Pakeha children ($M=4.78$) scoring higher than the Maori children ($M=4.08$).

The third hypothesis was that Samoan children, and to a lesser extent, Maori children would benefit more from the

Table 3

Mean Scores for the Student's Perception of Ability Scale by Condition and Ethnic Group

Scale	Condition and Ethnic Group							
	Competitive				Cooperative			
	Maori (N=35)	Pakeha (N=91)	Samoan (N=23)	Total Sample (N=149)	Maori (N=35)	Pakeha (N=102)	Samoan (N=23)	Total Sample (N=160)
Full Scale	44.34	45.15	49.83	45.68	44.94	45.51	48.22	45.77
General Ability	7.00	7.26	7.00	7.16	6.69	7.59	6.00	7.17
Mathematics	9.13	8.98	9.26	9.06	8.85	8.87	9.45	8.95
School Satis-faction	8.91	8.07	9.82	8.52	8.48	8.41	10.17	8.69
Reading/Spelling	7.77	8.74	9.24	8.60	8.48	8.29	8.70	8.38
Penmanship/ Neatness	8.29	7.65	8.87	7.99	8.48	7.78	9.05	8.11
Confidence	3.70	4.67	5.86	4.65	4.42	4.88	4.57	4.74

Note. Higher scores indicate a higher perception of ability

cooperative learning experience (on the self-concept variable) than the Pakeha children. Mean scores for the Student's Perception of Ability Scale for the separate ethnic groups in each condition, are displayed in Table 3. No significant interactions between ethnic group and learning condition were found for overall perception of ability or for any of the subscales.

Sociometric Measure

Two different analyses were performed on the sociometric data. A chi-square was used to examine differences in friendship choices made by children in the cooperative and competitive learning conditions. The test for significance of difference between two proportions was performed to examine the differences in choices made by each ethnic group within each condition. This test was chosen because of the varying sample size of each ethnic group.

As mentioned earlier, data from only the Maori, Pakeha and Samoan children were analysed in this study. However, for the purpose of the sociometric analysis, if subjects chose friends who were classifed as Maori/Pakeha or Samoan/Pakeha, those friends were included with the Maori or Samoan chldren.

The second hypothesis was that children in the cooperative learning condition would make more cross-ethnic friendship choices than those in the competitive learning condition. The results of the chi-square analysis (see Table 4) revealed no significant difference between the two conditions, in the percentage of "same" or "other" friendship choices made, ($\chi^2(1) = .54$, n.s. Children in the competitive condition

chose 385 friends from their own ethnic group and 413 from other ethnic groups. Children in the cooperative condition made 403 same-ethnic friendship choices and 467 cross-ethnic friendship choices. Therefore, there was no evidence to confirm the second hypothesis.

Table 4

Results of the Chi-square Analysis Showing the Number of Same-Ethnic Group and Cross-Ethnic Group Friendship Choices Made by Children in the Cooperative and Competitive Learning Conditions

Be my best friend			
Learning condition	N	Same	Other
Competitive	133	385	413
Cooperative	145	403	467

The results of the test for significance of difference between two proportions are shown in Table 5. This test compared the proportion of friendship choices made by each ethnic group, within each condition, to the proportion of the ethnic groups in the total sample.

As the results indicate, choices by the Maori children, and to a lesser extent, choices by the Samoan children, varied as an effect of learning condition. Both Maori and Samoan children in the competitive condition (but not in the cooperative condition) chose a significantly higher proportion of friends from their own ethnic group (M=37.63%), Z = 2.97, $p<.05$ and (M=24.24%), Z = 3.16, $p<.05$, in relation to the

proportion of that ethnic group in the total sample (25.74% and 12.87%). Maori and Samoan children in the competitive condition also made significantly fewer Pakeha choices (M=45.16%), Z = -2.70, $p<.05$, and (M=46.97%), Z = -1.99, $p<.05$, than the proportion of Pakeha children in the sample (56.93%).

In the cooperative condition, however, the two ethnic groups differed. Whereas the percentage of Pakeha choices by Maori children (56.25%) was similar to the proportion of Pakeha children in the sample (56.93%), the percentage of Pakeha choices by Samoan children (M=41.27%) was still significantly lower (Z = -3.07, $p<.05$). Therefore in respect to the choice of Pakeha friends, Samoan children were not influenced by learning condition.

None of the Samoan choices by Maori children, Maori choices by Samoan children or any of the choices by Pakeha children (see Table 5) varied according to learning condition. In each case, the percentage of choices made closely reflected the proportion of the ethnic groups in the sample.

To summarize, the second sociometric analysis showed that same-ethnic friendship choices were over-represented in the case of Maori and Samoan children in the competitive condition. Friendship choices of Pakeha children were underrepresented in the case of Samoan children in both conditions, but in the case of Maori children, only in the competitive condition. The proportion of friendship choices made by Pakeha children in both the cooperative and competitive learning conditions was similar to the proportion of ethnic groups in the sample.

Table 5

The Mean Percentage of Friendship Choices Made by Maori, Samoan and Pakeha Children in the Cooperative and Competitive Learning Conditions

Be my best friend		Friendship Choices		
Condition and ethnic group	N	Maori & Maori/Pakeha [a] (25.74%)	Pakeha (56.93%)	Samoan Samoan/Pakeha (12.87%)
Competitive	133			
Maori	31	37.63%*	45.16%*	13.98%
Pakeha	80	24.78%	58.95%	11.67%
Samoan	22	24.24%	46.97%	24.24%*
Cooperative	145			
Maori	32	30.21%	56.25%	9.37%
Pakeha	92	26.08%	57.97%	10.69%
Samoan	21	28.57%	41.27%*	19.84%

Note. The percentages of children chosen from other ethnic groups are not included in this table.

[a] Proportion of children in the sample.

* $p<.05$

DISCUSSION

The aim of this study was to investigate the effects of cooperative and competitive learning methods on the mathematics achievement, attitudes to school, self-concept and friendship choices of Maori, Pakeha and Samoan children.

The results showed that both the cooperative learning condition and the competitive learning condition had a significantly positive effect on the mathematics achievement of the sample as a whole. However, no overall differences between learning conditions were found for mathematics achievement, school attitude, self-concept or friendship choices. An examination of the scores of the different ethnic groups showed that the Samoan children improved the most on word problems and had the highest scores on the Cooperation, School Satisfaction, Penmanship/Neatness and Confidence subscales. The proportion of friendship choices also varied among the different ethnic groups. For Maori children, and to a lesser extent Samoan children, there was some evidence that cooperative learning encouraged more cross-ethnic friendship choices.

In the following discussion, the above results will be examined in the light of the previous research reviewed in the Introduction. The methodology of the present study will then be evaluated. Finally, conclusions will be drawn, and suggestions for future research considered.

Mathematics Achievement

Results of the achievement tests showed a significant improvement for the sample as a whole. However, contrary to the hypotheses, no significant main effects or interaction effect were found for learning condition or ethnic group for the complete multiplication test. While this finding is inconsistent with previous studies which have found strong positive effects of cooperative learning on student achievement (see Slavin, 1980, 1983), as well as ethnicity × learning interaction effects (Lucker et al., 1976; Slavin & Oickle, 1981), it is not dissimilar to findings of the Team-Assisted-Individualization (TAI) studies (Slavin, Leavey & Madden, 1984; Slavin, Madden & Leavey, 1984a, 1984b). These studies found no differences in the achievement of students using TAI and II (individualized instruction, without cooperative teams), when compared to control groups. Both TAI and II methods increased student achievement in mathematics more than the traditional group-paced methods. It was suggested by Slavin et al. (1984b) that the particular form of individualized instruction used, rather than cooperative learning teams, may explain the achievement effects found. Frequent mastery checks and self- and partner checking procedures, considered by Slavin et al. (1984b) to be distinguishing features of the TAI and II programmes (p.420), were also used in the present study. The pupils in both cooperative and competitive conditions were able to work at their own level and rate but did not need to spend a lot of time on skills they had already mastered. Self- and

partner-checking meant that in the majority of cases pupils were able to progress through the programme quickly without waiting for teacher assistance. This encouraged faster learning and maintained a high level of motivation.

The fact that the structured type of programme used in the present study was considered particularly suitable for children who were Polynesian (Fairbairn-Dunlop, 1981; Hunkin, 1985) or from a lower socio-economic group (Hunkin, 1985) may also have contributed to the significant level of maths improvement by Maori, Pakeha and Samoan children in both conditions.

Another factor which may have had a similar effect on children in both cooperative and competitive learning groups and all three ethnic groups was the opportunity for pupil interaction provided by the individualized programme. Informal observations conducted during a TAI study by Slavin et al. (1984b) indicated that interaction was common among students using the individualized programme whether, or not, they were in learning teams. This level of interaction by students in TAI and II classes was higher than that of students in control classes.

Comments made by teachers in the present study indicated that children in the competitive clusters (as well as those in the cooperative clusters) frequently helped each other, even though it was not to their personal advantage to do so. This suggested that cooperative learning was preferred by many pupils and that their use of this approach may have contributed to their improvement in mathematics. However,

without a control group, it is impossible to determine the extent to which learning was influenced by the distinguishing features of the individualized programme used in the present study, such as mastery checking procedures and group work.

Results showed a significant ethnicity × test interaction effect for word problems. The mean scores indicate that both Samoan and Maori children improved more than the Pakeha children. As the majority of Samoan children in New Zealand speak Samoan at home but receive much encouragement from their parents to learn English well at school (Fairbairn-Dunlop, 1984), it makes sense that an increased amount of interaction at school would result in increased improvement in the language with which they are not as familiar as the Pakeha children. The Maori children's competence with the English language is unknown. It is not wise to make generalizations from previous studies in other parts of New Zealand. However, it is an important finding that the Maori children too improved more at word problems than the Pakeha children (though less than the Samoan children). These results present a strong case for the use of group-oriented learning methods in language-related subjects.

School Attitude

Contrary to the hypotheses, analysis of the School Attitude Survey indicated no significant main or interaction effects for learning condition or ethnic group on the General School Attitude or Competition scales. Most of the previous research which found that cooperative learning had positive effects on affective variables used traditional or individual

learning methods as a means of comparison. Humphreys et al. (1982) who used both competitive and individual groups found that the cooperative group had a more positive attitude to their own goal structure than did the other two groups to their goal structure. However, pupils in the competitive group in the study by Humphreys et al. (1982) actually worked individually. The findings of the present study cannot be compared to the above results as a different design was used. The TAI studies (Slavin, Leavey & Madden, 1984; Slavin, Madden & Leavey, 1984b) found that students using both team-assisted and individual methods of using the individualized programme had more positive attitudes to mathematics than the control group. In the light of these results the lack of significant effects on General School Attitude in this study is not surprising. It is possible that some feature of the individualized programme is having a stronger effect on pupils' attitudes than the actual reward structure used.

Results of the present study showed a significant main ethnicity effect on the Cooperation scale. Mean scores showed that Samoan children had the most positive attitude to cooperation and Pakeha children the least positive. This is consistent with research which showed that Polynesian children prefer working cooperatively (Graves & Graves, 1974; 1984; Pitt & Macpherson, 1974; Thomas, 1975, 1978). The finding that there was no ethnic group difference on the competition scale is not surprising as Polynesian children are used to competition, in the intergroup form. Besides Johnson and Ahlgren (1976) found that student attitudes towards

cooperation and competition can be quite independent from one another.

Self-concept

There were no significant differences between the two conditions, in academic self-concept. This is an important finding, as most of the past research which found positive effects of cooperative learning on self-esteem (Blaney et al., 1977; Madden & Slavin, 1983; Slavin & Karweit, 1979) compared cooperative learning with individual or traditional learning methods, but not with competitive learning. The finding of the present study is similar to that of other New Zealand research (Thomas, 1985) which found no difference between cooperative and control groups on the self-esteem measure. The absence of any difference, between the cooperative and competitive learning condition, in self-concept in mathematics found in this study was consistent with the results of one of the TAI studies (Slavin, Madden & Leavey, 1984) which failed to find any difference between TAI and II groups and control groups.

It appears, therefore, that when a similar task structure is used, cooperative and competitive reward structures, on their own, may have little effect on self-esteem.

Significant ethnic group differences were found on some of the subscales of the measure of academic self-concept. Mean scores indicate that, for the School Satisfaction and Penmanship/Neatness subscales, Samoan children had the highest perception of themselves and Pakeha children, the lowest. On the Confidence subscale, the Samoan scores were the highest

and Maori scores the lowest.

The results for the Samoan children are consistent with research which shows that Samoan children usually come from a home background where cultural values are strong and educational encouragement is consistent (Fairbairn-Dunlop, 1981). Psychological theory suggests that consistency of parents' values and appraisals make a considerable contribution to the development of a strong self-concept (Atkinson, Atkinson & Hilgard, 1983).

The mean scores of the Maori children on the Student's Perception of Ability Scale confirm recent New Zealand findings that Maori children do not have a lower academic self-concept (Chapman, 1984) or lower self-esteem (Thomas, 1985) than Pakeha children. These results were in contrast to previous research (Ranby, 1979) which found a lower self-concept for Maori pupils. On the Confidence subscale, results of the present study differed from those of Chapman (1984) who found no differences between Maori and Pakeha children.

Friendship Choices

Results of this study showed no significant main effect of learning condition on friendship choices, contrary to the findings of the majority of other studies which examined the effect of different learning conditions on interpersonal relationships within the classroom (DeVries, Edwards & Slavin, 1978; Slavin, 1979; Warring et al., 1985; Ziegler, 1981). This could be accounted for by the reported interaction among members of both cooperative and competitive clusters.

An examination of ethnic group differences showed that friendship choice patterns were similar to those found by Edgerley (1972), Morrison (1978) and Weigel et al. (1975). The present study partially supported the findings of the above that members of student's own ethnic group were over-represented in friendship choices made. In this study, this was true in some cases for Samoan and Maori children, but not for Pakeha children. A similar Maori/Pakeha difference was found by Edgerley (1972) for pupils in their first year at secondary school.

Learning condition appeared to have some effect on the friendship choices made by Samoan and Maori children. Same-ethnic friendship choices were over-represented by these two groups only in the competitive condition. Likewise, it was only in the competitive condition that the Pakeha friendship choices by Maori children were under-represented. United States research findings on race × treatment interactions have been inconsistent. Thomas (1985), who conducted the only known New Zealand studies in this area, found that cooperative learning had no significant effects on the friendship choices of Maori and Pakeha children.

The finding of the present study that the cooperative and competitive reward structure had an ethnicity × condition interaction effect on friendship choices but not on any of the other variables is interesting. It implies that Maori children, and to a lesser extent, Samoan children show less liking for children of other ethnic groups with whom they have worked competitively. This finding suggests that the use of a

group-oriented learning approach using a cooperative reward structure may be beneficial for interpersonal relationships in the multi-cultural classroom. However, further studies are needed to see if the same friendship patterns are replicated.

Evaluation of methodology

The results of the present study indicate few differences between the cooperative and competitive learning methods on mathematics achievement, school attitude or self-concept. As children in both conditions improved significantly in mathematics, it appears that both group-oriented methods are beneficial for achievement. However, further research is necessary to determine whether these group-oriented methods have a more positive effect on learning than traditional or individual methods.

Implementation checks indicated that the reward structures were being used appropriately by all classes. However, it was found, during the intervention, that the sets within the Mathematics Units were sometimes too long to be completed in one day by the slower pupils. As these children only had the opportunity of being rewarded every second day, the effects of both cooperative and competitive reward structures may have been weakened. In a future study, this problem could be avoided by testing units with a larger sample and by omitting children with extremely low scores from the statistical analyses. It is possible, too, that the effects of the competitive reward structure may have been weakened as a consequence of the group-oriented individualized approach used in this study. Because the competitive clusters were

small and children were working at their own level, they had a good chance of "having a turn" at being first or second. Group size, and level of competition therefore, could be important variables mediating the relationship between competition and achievement and affective variables.

Although the small size of the clusters may have reduced the effects of the rewards given to the competitive group in the present study, the quantity of reward given to each condition was carefully controlled. In some earlier studies (e.g. Slavin, 1979; Slavin et al., 1984, 1984b; Weigel et al., 1975), rewards were given to children in the cooperative learning condition, but not to those in the control group or in the individual learning condition. It is possible that rewards, rather than cooperative learning, contributed to the positive effects found for the cooperative condition. In the present study, children in both conditions were rewarded equally.

As mentioned in the Introduction, some researchers compared small learning groups, in one condition, with one large group, in the other (Humphreys et al., 1982; Slavin & Karweit, 1981; Weigel et al., 1975). This confounded the effects of group learning with those of cooperative learning. In the present study, these two variables were kept separate, as children in both conditions were assigned to small groups.

The cooperative and competitive learning methods were only used for one class period each day, over a period of three weeks. Johnson, Johnson, Buckman and Richards (1985) found that students who experienced cooperative learning less

than half of the instructional time did not like cooperative learning as much as those who experienced it half of the time or more. It is possible, therefore, that a learning condition effect may have appeared if the same methods were used for a greater part of the school day.

It was mentioned earlier that teachers reported the frequent occurrence of cooperative interaction among children of the competitive clusters. While this information is useful, direct observation would provide more detailed information about group processes in the classroom situation.

Whereas teachers found it took a few days to become familiar with experimental procedures and the use of individualized programmes, comments made by the majority of teachers at the end of the intervention were very favourable. A number asked to keep the programme for future use as their pupils enjoyed using it, were well motivated and could work at their own level. The greater opportunity for peer teaching provided by the use of small groups, freed the teacher to give more assistance to individuals. One teacher specifically mentioned that he would continue to use a group-oriented learning approach in his classroom.

Conclusions

In conclusion, the findings of this research suggest that group-oriented learning methods using either a cooperative or a competitive reward structure may be beneficial in improving the mathematics achievement of Maori, Samoan and Pakeha children in the middle Primary School. There appears to be little difference in the effect of the two approaches on

school attitude or self-concept. However, competitive learning may not be as effective as cooperative learning in encouraging Polynesian children to make more cross-ethnic friendship choices. More research is needed to study the effects of specific features of the group-oriented individualized programme and to further explore its suitability for use in the New Zealand multi-cultural classroom.

Footnotes

1) In part 1, the response scale is a set of three faces; smiling, neutral and frowning. Pupils were asked to fill in the nose on the face that showed how they felt about each item. Possible scores for each item in Part 1 range from 0 to 2. Each item of Part 2 consists of a statement e.g. "I like to have other children help me learn," followed by a four-level true-false scale: very true, sort of true, sort of false and very false. The pupils were asked to fill in one circle on the scale that showed how true or false a statement was for them. Possible scores for each item in Part 2 ranged from 0 to 3.

2) Items relating to internal and external motivation and self-expression were also included on the questionnaire. However, after subsequent deliberation, these items were not considered entirely relevant to the present study. For this reason, the following items were omitted from the final analysis: Part 1, Items 10, 11, 15, 16, 19, 20; Part 2, Items 6-11, 13, 28.

3) For example, the word "arithmetic" was changed to "maths", "smart" changed to "clever" and "grade(s)" changed to "mark(s)".

4) Chapman (1983) changed the word "arithmetic" to "maths" and "smart" to "clever". Additional changes introduced in the present study were as follows: "dumb at maths" was changed to "poor at maths", "tests are easy for me to take" was changed to "tests are easy for me to do" and "good with my times tables" was changed to "good at my times tables".

5) The sociometric measure in the present study differed from that used by Thomas (1985) in two ways. Firstly, the columns headed "invite to my house"and "sit next to in class" were omitted. As Thomas found, in the first of his 1985 studies, that seating and friendship choices were highly correlated, it was considered sufficient to use only the friendship choice measure in this study. Secondly, in the present study, children were asked to limit the number of choices to six. This was because the measure was used in a different way from Thomas (1985), who examined the effects of cooperative learning techniques on popularity. The present study was similar to other studies which analysed the ethnic group membership of the first six friends chosen (Madden & Slavin, 1983; Slavin & Oickle, 1981).

6) The numbers and degrees of freedom vary among the different analyses, as some children were either absent during the administration of one or more of the measures, or filled in a questionnaire incorrectly.

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LIST OF APPENDICES

APPENDIX 1

MULTIPLICATION TEST 1

Please do not write in these boxes

Col 1-4 [ ][ ][ ][ ]

Name _____

Age _____ Class _____

6 [ ]

Please answer these questions by ticking the right box.

8 [ ][ ]

Are you a -

11 [ ]

Boy [ ] Girl [ ]

13 [ ]

Samoan [ ]

Pakeha [ ]

15 [ ][ ]

Maori [ ]

17 [ ][ ]

From another country [ ]

19 [ ][ ]

FOR TEACHER'S USE ONLY

Scores

21 [ ][ ]

Algorithms [ ]

Word problems [ ]

Total [ ]

Starting level [ ]

Test 1

Please do not write in these boxes

MULTIPLICATION FORM A

Step 1 a) $2 \times 7 =$ b) $6 \times 5 =$ c) $9 \times 4 =$

If 1 sweet costs 3¢, then 5 sweets cost ☐ ¢

24-26 ☐☐☐

27 ☐

Step 2 a) $\begin{array}{r} 9 \\ \times\ 8 \\ \hline \end{array}$ b) $7 \times 6 =$ c) $\begin{array}{r} 8 \\ \times\ 0 \\ \hline \end{array}$

If 1 packet holds 8 crayons, then 7 packets hold ☐ crayons.

28-30 ☐☐☐

31 ☐

Step 3 a) $\begin{array}{r} 33 \\ \times\ 2 \\ \hline \end{array}$ b) $\begin{array}{r} 54 \\ \times\ 2 \\ \hline \end{array}$ c) $\begin{array}{r} 41 \\ \times\ 3 \\ \hline \end{array}$

What is the cost of 3 rubbers at 32¢ each?

32-34 ☐☐☐

35 ☐

Step 4 a) $\begin{array}{r} 56 \\ \times\ 3 \\ \hline \end{array}$ b) $\begin{array}{r} 45 \\ \times\ 5 \\ \hline \end{array}$ c) $\begin{array}{r} 96 \\ \times\ 7 \\ \hline \end{array}$

14 children have 3 biscuits each.
How many biscuits altogether?

36-38 ☐☐☐

39 ☐

Step 5 a) $\begin{array}{r} 246 \\ \times\ 9 \\ \hline \end{array}$ b) $\begin{array}{r} 604 \\ \times\ 7 \\ \hline \end{array}$ c) $167 \times 8 =$

If a train can carry 270 passengers, how many can it carry altogether in 6 trips?

40-42 ☐☐☐

43 ☐

Please do not write in these boxes

Col 44-46

Step 6 a) 24 × 10 b) 32 × 40 c) 74 × 60

47

68 children each sold 20 raffle tickets.
How many tickets did they sell altogether?

48-50

Step 7 a) 65 × 33 b) 27 × 62 c) 81 × 49

51

Tane delivers 56 newspapers each day.
How many does he deliver in 31 days?

52-54

Step 8 a) 134 × 28 b) 402 × 37 c) 830 × 48

55

How much will the school pay for 134 books at $25 each?

56-58

Step 9 a) 28 × 100 b) 306 × 200 c) 420 × 500

59

There are 36 books on each library shelf.
How many books altogether on 300 shelves?

60-62

Step 10 a) 27.64 × 5 b) 1.98 × 7 c) 20.57 × 6

63

What is the price of 4 radios at $29.95 each?

MULTIPLICATION TEST 2

Col. 1-4

Name _____

FOR TEACHER'S USE ONLY	Scores
Algorithms	
Word problems	
Total	
Finishing level	

Please do not write in these boxes

Col 6

7

8

9

Test 2

Please do not write in these boxes

MULTIPLICATION FORM B

10-12

Step 1 a) $2 \times 6 =$ b) $7 \times 5 =$ c) $8 \times 4 =$

If 1 lollipop costs 8¢, then 3 lollipops cost [ ] ¢.

13

[ ]

14-16

Step 2 a) $\begin{array}{r} 9 \\ \times\ 7 \\ \hline \end{array}$ b) $8 \times 6 =$ c) $\begin{array}{r} 7 \\ \times\ 0 \\ \hline \end{array}$

If 1 packet holds 8 pencils, then 9 packets hold [ ] pencils.

17

[ ]

18-20

Step 3 a) $\begin{array}{r} 42 \\ \times\ 2 \\ \hline \end{array}$ b) $\begin{array}{r} 23 \\ \times\ 3 \\ \hline \end{array}$ c) $\begin{array}{r} 51 \\ \times\ 3 \\ \hline \end{array}$

What is the cost of 23 bubble gums at 3¢ each?

21

[ ]

22-24

Step 4 a) $\begin{array}{r} 46 \\ \times\ 2 \\ \hline \end{array}$ b) $\begin{array}{r} 95 \\ \times\ 7 \\ \hline \end{array}$ c) $\begin{array}{r} 56 \\ \times\ 5 \\ \hline \end{array}$

7 children have 12 marbles each.
How many marbles altogether?

25

[ ]

26-28

Step 5 a) $\begin{array}{r} 206 \\ \times\ 8 \\ \hline \end{array}$ b) $\begin{array}{r} 644 \\ \times\ 9 \\ \hline \end{array}$ c) 167×7

If a plane can carry 225 passengers, how many can it carry altogether in 8 trips?

29

[ ]

Please do not write in these boxes

Step 6 a) 32 × 10 b) 24 × 60 c) 74 × 40

59 children each played 10 video games.
How many games did they play altogether?

Col 30-32

33

Step 7 a) 27 × 33 b) 65 × 49 c) 81 × 62

Tamara swims 65 lengths of the pool each day.
How many lengths does she swim in 21 days?

34-36

37

Step 8 a) 128 × 43 b) 204 × 28 c) 720 × 38 =

How much will a farmer pay for 145 sheep at $24 each?

38-40

41

Step 9 a) 29 × 100 b) 307 × 200 c) 430 × 500

There are 28 slices in one loaf of bread.
How many slices in 200 loaves of bread?

42-44

45

Step 10 a) 26.74 × 5 b) 1.79 × 8 c) 27.50 × 6

What is the price of 2 chairs at $49.95 each?

46-48

49

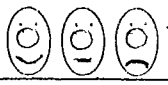
APPENDIX 2

1-4

SCHOOL ATTITUDE SURVEY

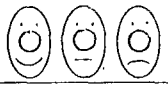
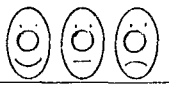
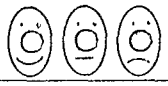
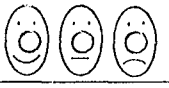
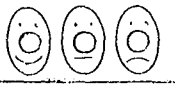
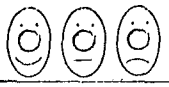
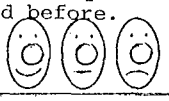
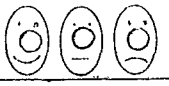
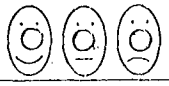
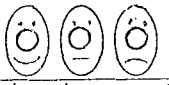
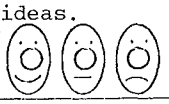
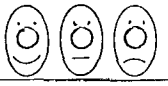
Sample question for Part 1.

0. Watching TV at home

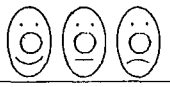
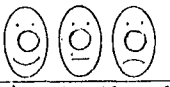
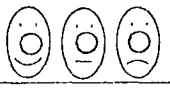
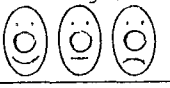


Fill in the nose of the face that shows how you feel about what is written in the box.

Please do not write in these boxes

1. Learning maths 	2. Learning to read better, 	6
3. Learning language (English) 	4. Learning spelling 	
5. Learning science. 	6. Following school rules 	
7. Listening to the teacher 	8. Writing stories 	
9. Being a good learner 	10. Answering questions I have already heard before. 	
11. Answering questions I have never heard before. 	12. Children who aren't as clever as I am. 	
13. Children who are cleverer than I am 	14. Getting good marks 	
15. Talking in a small group about my own ideas. 	16. Talking in a small group about my own feelings. 	20

Please do not write in these boxes

17. Doing tests 	18. My friends 
19. Talking to the whole class about my own ideas 	20. Talking to the whole class about my own feelings. 

22 ☐☐

24 ☐☐

Sample question for Part 2.

0. I like to get up early.	O-O-O-O true false

PART 2

Fill in one circle for each sentence to show how true it is for you.

26

1. I have to hurry to finish my work in class.	O–O–O–O true false	
2. My teachers care about how much I learn.	O–O–O–O true false	
3. My teachers like me the way I am.	O–O–O–O true false	
4. I like to have other children help me learn.	O–O–O–O true false	
5. I would rather work with other children than by myself.	O–O–O–O true false	
6. I do schoolwork to make my teachers happy.	O–O–O–O true false	
7. I do schoolwork to make my parents happy.	O–O–O–O true false	
8. I do schoolwork to keep my teachers from getting angry at me.	O–O–O–O true false	
9. I do schoolwork because it is interesting.	O–O–O–O true false	
10. I do schoolwork so other children will like me.	O–O–O–O true false	
11. I do school work because it's fun.	O–O–O–O true false	
12. My friends want to do better work than I do.	O–O–O–O true false	
13. I like to learn at school.	O–O–O–O true false	
14. I like to do better work than my friends.	O–O–O–O true false	39

Please do not write in these boxes

40

15. My teachers like to help me learn.	○-○-○-○ true false	
16. I am just as important in the school as any other child.	○-○-○-○ true false	
17. My teachers give me too much work to do.	○-○-○-○ true false	
18. I'm doing a good job of learning at school.	○-○-○-○ true false	
19. I feel I am a part of what is going on at school.	○-○-○-○ true false	
20. My teachers like me as much as they like other students.	○-○-○-○ true false	
21. Work at school is often too hard for me.	○-○-○-○ true false	
22. I like to get better marks than other children do.	○-○-○-○ true false	
23. I have many questions I don't get a chance to ask.	○-○-○-○ true false	
24. I like to help other children learn.	○-○-○-○ true false	
25. I like to have the teacher see my work.	○-○-○-○ true false	
26. My teachers like to see my work.	○-○-○-○ true false	
27. Other children like me.	○-○-○-○ true false	
28. My marks at school really show how much I know.	○-○-○-○ true false	

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APPENDIX 3

STUDENT'S PERCEPTION OF ABILITY SCALE

DIRECTIONS

This booklet has a list of statements about how you feel about school. Some of these are true and some are not. Circle the YES if the statement is usually true of you. Circle the NO if the statement is not usually true of you. Read each question carefully and answer every item, even if it is hard to decide which answer is most like you. Do not circle both YES and NO. Just circle one answer for each statement. This is not a test so there are no right or wrong answers. Please mark exactly how you really feel inside about school.

Col. 6

1.	I always understand everything I read.	YES	NO	
2.	My school work is usually untidy.	YES	NO	
3.	All new words are easy for me to spell.	YES	NO	
4.	I find it hard to understand what I have to do.	YES	NO	
5.	I think my school work is really good.	YES	NO	
6.	I usually have problems understanding what I read.	YES	NO	
7.	I am one of the cleverest kids in the class.	YES	NO	
8.	I have neat printing.	YES	NO	
9.	I usually finish my schoolwork.	YES	NO	
10.	I am unhappy with how I read.	YES	NO	
11.	I like reading.	YES	NO	
12.	My printing is perfect.	YES	NO	
13.	I am good at spelling.	YES	NO	
14.	I make many mistakes in school.	YES	NO	
15.	I have problems in spelling.	YES	NO	
16.	I like to read to my parents.	YES	NO	
17.	I am happy with the way I spell.	YES	NO	
18.	I like making up endings to stories.	YES	NO	
19.	My teacher thinks I write poor stories.	YES	NO	
20.	I am poor at subtraction.	YES	NO	

21.	I like to answer questions.	YES	NO	
22.	Working with my hands is hard.	YES	NO	
23.	I like doing printing.	YES	NO	
24.	I have trouble drawing pictures.	YES	NO	
25.	I am poor at silent reading.	YES	NO	
26.	I have problems printing neatly.	YES	NO	
27.	I am good at my times tables.	YES	NO	
28.	I am good at drawing.	YES	NO	
29.	When school gets tough I give up.	YES	NO	
30.	I like to do story problems.	YES	NO	
31.	My friends read better than I do.	YES	NO	
32.	I am good at printing.	YES	NO	
33.	I always do neat work.	YES	NO	
34.	I have difficulty getting my maths finished on time.	YES	NO	
35.	I have difficulty working with numbers.	YES	NO	
36.	I like spelling.	YES	NO	
37.	I like maths.	YES	NO	
38.	I am a messy writer.	YES	NO	
39.	Tests are easy for me to do.	YES	NO	
40.	I like to sound out words.	YES	NO	
41.	My teacher often makes me write my work again.	YES	NO	
42.	I have difficulty looking up words in the dictionary.	YES	NO	
43.	I like to use big words when I talk.	YES	NO	
44.	I like telling my friends about school work.	YES	NO	
45.	My teacher thinks I am poor at maths	YES	NO	50

46.	I like going to school.	YES	NO	
47.	I like playing spelling games.	YES	NO	
48.	I have difficulty thinking up good stories.	YES	NO	
49.	My spelling is always right.	YES	NO	
50.	Saying new words is hard for me.	YES	NO	
51.	I am unhappy with how I do maths.	YES	NO	
52.	I am a clever kid.	YES	NO	
53.	I have difficulty doing what my teacher says.	YES	NO	
54.	I find spelling hard.	YES	NO	
55.	I usually get my maths right.	YES	NO	
56.	I find reading hard.	YES	NO	
57.	I am unhappy with my printing.	YES	NO	
58.	I am a good reader.	YES	NO	
59.	I am slow at spelling.	YES	NO	
60.	I am a slow reader.	YES	NO	
61.	In school I find new things difficult to learn.	YES	NO	
62.	I usually spell words right.	YES	NO	
63.	My teacher thinks I am good at printing.	YES	NO	
64.	All new words are hard for me to understand.	YES	NO	
65.	I have trouble telling others what I mean.	YES	NO	
66.	I am good at maths.	YES	NO	
67.	I like to tell stories in class.	YES	NO	
68.	I feel I often say the wrong things.	YES	NO	
69.	I find multiplication fun.	YES	NO	
70.	I always get everything in maths right.	YES	NO	

APPENDIX 4

Teacher guidelines for research on cooperative and competitive learning methods

This study will examine the effects of cooperative and competitive learning methods on the mathematics achievement, attitudes to school and academic self-esteem of Maori, Samoan and Pakeha children.

The dates of the various parts of the study are as follows:

18th-19th July	Mathematics pre-test.
20th July (a.m.)	Marked tests are collected.
20th-22nd July	Tests are sorted and children assigned to appropriate maths step. Class groupings are worked out. Individualized maths materials are sorted for each class and more photocopied if necessary. Materials are then delivered to each school.
25th July-8th Aug.	Cooperative and competitive learning intervention.
8th-9th August	Mathematics post-test, attitude to school and academic self-esteem questionnaires are administered.

This set of guidelines includes the following:

(1) Instructions for the administration of the mathematics pre-test.

(2) Overview of procedure for the cooperative and competitive learning intervention
   a) Grouping
   b) Materials
   c) Timing and duration of the cooperative and competitive maths programme
   d) Duration of lesson.

(3) Description of daily procedure. Summary of procedure.

(4) Differences between cooperative and competitive conditions
   a) Rules for obtaining assistance when working on units.
   b) Scoring.

(5) Checking of scoring cards and allocation of stars.

(6) Checking of completed worksheets.

(7) Pupil preparation and familiarization with materials and procedures.

(8) Objectives and teaching notes for multiplication units.

(9) Teaching sessions.

(10) Mathematics post-test and questionnaires.

1) Administration of Mathematics Pre-test

(1) Date of Administration:
Please administer the Mathematics pre-test on Monday 18th or Tuesday 19th July.

(2) Absentees
If any children are absent please let me know when I collect the completed test forms on Wednesday 20th and we will make arrangements for supervising them at another time.

(3) Timing
Please administer the test in the morning, before the children become too tired. The test should not follow any exciting event.

(4) Duration of Test
The children are to have as much time as they need.

(5) Preparation

1) Materials: The children will need a pen or a dark pencil so answers can be clearly read and scrap paper for working out. Answers only are to be written on the test form.

2) Seating: Children should be seated in such a way that they are unable to copy each other's answers.

3) Multiplication tables: Any wall charts, books, etc. containing multiplication tables should be well out of sight.

4) Notice on classroom door: Interruptions are very distracting during a test. Please hang up a notice outside, such as-Do not disturb - testing in progress.

5) Work for children who finish early: As the test is not timed, children who finish early need to have a book, project, etc. on their desk to go on with after they have

completed the test. Please ask the children to turn their test upside down on their desks when they have finished.

(6) Administration of Test

Please place all Maths tests upside down on the children's desks. Then read the following instructions:

Instructions for children

This is a test to see how well you understand multiplication. You have as long as you need to complete the test. Please write your answers clearly on the test form. Do not write in the little boxes on the side. Do all your working out on scrap paper.

Please answer as many questions as you can. You must do your own work. I will not be able to help you. If you can't understand a question, leave it and go on to the next one.

When you have finished, check your answers, turn your paper upside down on your desk and quietly read your book (or do your project, etc.). Do not leave your desk.

Are there any questions?

Turn your paper over and write your name on the paper.
Now fill in the other questions (teacher can read out the questions on the cover sheet but not the maths questions).
Turn over the page and begin the test.

After the test:

1) Collect the test papers and put into the envelope provided.
2) Fill in the form on the front of the envelope.

(7) Marking

As there will be only a few days for marking 400 tests and dividing children into groups, I will provide answer sheets for you to mark the tests done by your own class. Marking will have to be completed by the time I collect the tests on Wednesday. Please let me know early if you have any difficulty.

If you ask the pupils to mark each other's tests, it is important that you let me know, because each answer will have to be checked.

(2) Procedure for the cooperative and competitive learning intervention

Grouping

The class will be divided into two large groups - the cooperative condition and the competitive condition. The composition of these two groups will be as similar as possible as regards maths ability, sex and ethnic group. Children within each condition will be divided into small groups, or clusters of approximately 4 children. Children of different sexes and ethnic groups will be evenly distributed among the clusters, but wherever possible children of different maths ability will be randomly assigned.

I suggest that you choose a name for each condition and cluster e.g. planets (name of condition) and Pluto, Neptune, Jupiter and Mars (names of clusters). Other names could include spaceships, bears, birds, etc.

Materials

Multiplication units: During the cooperative and competitive learning intervention the children will be working on individualized multiplication units. These consist of ten colour-coded units based on the ten steps of the cyclic approach designed by Eleanor Burt (Gilberthorpe School) and recommended by Barry Brooker, Maths Advisor. Each unit consists of a number of sets and answer sheets, checkouts (10-item tests to follow each set) and checkout answers. These materials will be kept in boxes easily accessible to the children, who will select their own materials throughout the lesson.

Envelopes: Each child will keep completed work (with the exception of checkout answers) in a large envelope which I will provide.

Paper: The children will need paper to write on. Please let me know if you have any trouble providing this.

Scoring cards: I will prepare a scoring card for members of each small group. These will also be kept in boxes.

Stars: I will provide these for use with the scoring cards. (For more detail, refer to p.8).

Conference Chart: I suggest that you pin up a large sheet of paper near your desk for children to write their names on when they need

to see you after completing and marking a checkout. They can then work at their desks until you are ready to see them. This may help with organization and will also provide a record of children who have required assistance.

Class list: I will provide you with a copy of your class list specially prepared for daily recording of

a) names of absentees.

b) children who have been given extra assistance (group or individual).

Timing and Duration of cooperative and competitive maths programme

The children will work on the multiplication units for just over two weeks from 25th July to 8th August.

Duration of lesson: Each lesson should last 40-45 minutes. This should give most children sufficient time to complete a set each day. However, as some sets are more difficult than others, on occasions a set may have to be completed the following day.

3) Description of daily procedure

The following procedure applies to the second and subsequent lessons. Guidelines for the first lesson are given on p.10.

1) The children move into their small groups (clusters).

2) They collect the multiplication set they will be working on for the day or alternatively they receive their set from monitors appointed to distribute sets of a particular colour. The use of monitors is recommended for distribution of materials at the beginning of each lesson to ensure that disruption is minimal.

3) Working on sets within units. The children begin working on their set, writing their answers on separate paper (not on the worksheet which has to be used by other children). They are to begin answering all circled items.

4) When they have completed this task, they go to the box, find the appropriate answer sheet and mark their own work. If there is anything they do not understand, they can seek help at this point.

5) The answer sheet and set are then returned to the box and the appropriate "STOP CHECK" collected.

Completing the checkouts: It is important that the children complete all "STOP CHECK" items on their own without assistance from anyone.

6) The "STOP CHECK" answer sheet is then collected from the box and work taken to another child in the same cluster for marking. The score (number right and number completed) is recorded in pencil on the group scoring card and the checkout answer sheet returned.

7) 80% correct ($\frac{8}{10}$) is the minimum criterion for going on to the next set.

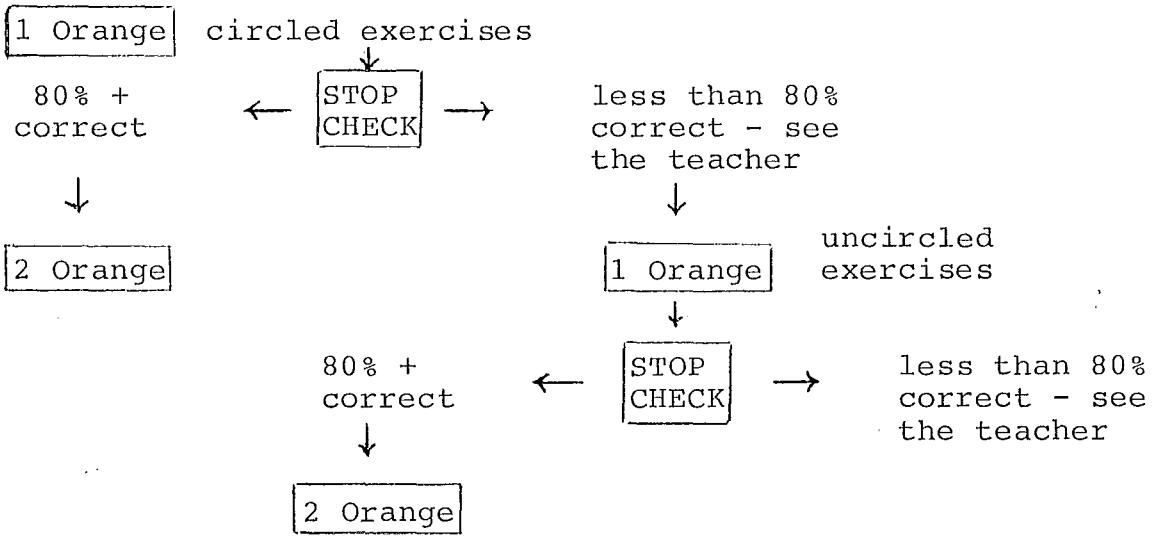
   a) If the children score below 80% they make an appointment to see the teacher by writing their names on the conference chart, collect the same set again and begin answering the uncircled items while waiting for a conference.

   N.B. After the conference, the children must leave their checkout answers with the teacher so that when they repeat the checkout they will not be able to copy their original correct answers.

   If the children still score below 80% after the second attempt at the checkout, I suggest that they proceed to the next set.

   b) If the children score higher than 80% on a checkout they begin working on the circled items of the next set.

Perhaps this diagrammatic description of the procedure will help. I will use the first set of the first unit - 1 Orange as an example.



The following summary of the procedure may be a handy reference for teacher or children:

(1) Move into small groups (clusters).

(2) Wait for sets to be distributed by monitors.

(3) Work on sets (circled items first).

(4) Go to box and find appropriate answer sheet. Mark own work. Ask for help if necessary.

(5) Put set back in box and find appropriate checkout.

(6) Answer checkout questions.

(7) Go to box and find appropriate checkout answer sheet. Take work to another member of cluster for marking.

(8) Write score in pencil on cluster card.

(9) Return checkout to box.

(10) If $\frac{8}{10}$ or over, collect the questions for the next set.
If less than $\frac{8}{10}$, write name on conference chart, take same set from box and answer uncircled questions.

(11) Leave own "STOP CHECK" answers with teacher after conference.

(12) Repeat same "STOP CHECK".

4) Differences between cooperative and competitive conditions

The above procedure applies to both cooperative and competitive conditions. The main differences lie in the rules for obtaining assistance and in the scoring procedure.

Rules for obtaining assistance when working on units

Cooperative group

1) Children must be willing to help any group member who asks (but only when asked).

2) Children may ask the teacher for help only when they have asked everyone else in the group for help first, or if the teacher gives a short lesson (refer to p.12).

Competitive group

The children are given no specific rules about when to provide help or about whom to ask for help. Since they are to try and do better than other members in their group, they may decide not to help each other, but it is up to them to choose. They are required to mark the checkouts of other members of their cluster but no explanatory assistance is demanded of them.

Scoring

Cooperative group

At the end of each checkout, children write (in pencil) their own score on the sheet on the back of their scoring card. If they complete a second checkout in the same lesson, this score can be adjusted to include the second score. At the end of the lesson, the children's scores are totalled and averaged to give a group score. This is then written on the front of the card.

Competitive group

Upon the completion of each checkout, the children write their individual scores on the front of their cluster scoring card in pencil so that a second checkout score obtained during the same lesson may be added onto the first score.

No group score is calculated. At the end of the lesson individual scores are ranked.

5) Checking of scoring cards and allocation of stars

At the end of each lesson scoring cards are put in a box and given to the teacher for checking. The adding and averaging of scores will have to be checked for accuracy before the next maths lesson.

1st and 2nd placegetters in each of the competitive clusters will require a star by their name on the scoring card.

Each child in a cooperative cluster which has scored above a moderately high criterion will also receive a star.

After checking the cards, please tear off the sheets of paper at the back of the cooperative cluster cards and place these in an envelope so that the next day the small group score only will be recorded on the card.

N.B. Approximately the same number of stars (about 40) should be awarded to each condition during the period of a week.

Criterion for cooperative group

I suggest that the criterion for receiving a star be set at a group score of 18 for the first day or two. You can then raise or lower this depending on the performance of your own class. The children should be told what the criterion will be.

If more stars are being earned daily by those in the cooperative condition than those in the competitive condition e.g. 8 by the cooperative and 6 by the competitive, then 1st and 2nd place-getters in the competitive condition overall may also be rewarded a star to even the numbers out.

Below are examples of scoring cards.

Competitive Condition

Monday

		Number Correct	Number Completed	Total	Place in group
Group A	Jane	6	10	16	4th
	Pat	10	10	20	2nd *
	Aroha	17	20	37	1st *
	Tane	8	10	18	3rd

(all 5 days will be included on the actual card)

Cooperative Condition

		Mon.	Tues.	Wed.	Thurs.	Fri.
		17	19	16	20	17
Group A	Jackie		*		*	
	Paula		*		*	
	Mike		*		*	
	Marama		*		*	

Monday

Group A	Number Correct		Number Completed	
Jackie	6		10	
Paula	10		10	
Mike	17		20	
Marama	8		10	
	41	+	50	= 91

$$4 \overline{)91} \quad 22\,3/4$$

Group score - $22\,3/4$

(Note: Small group members may choose an original name for their group)

6) Checking of completed worksheets

At the end of each lesson individual children's envelopes containing the work they have done are collected and stored together so that they are easily accessible to the teacher and experimenter for checking. A few of these will have to be checked each day.

7) Pupil preparation and familiarization with materials and procedures

Most of Day One (Monday 25th July) will be spent preparing the children for cooperative or competitive work on the maths units.

Below is a suggested explanation to give the pupils when introducing them to the cooperative and competitive learning programme.

"Today we will begin studying multiplication. The way we will be working over the next two weeks will be a bit different from what you are used to."

Now briefly describe the contents of the individualized programme i.e. ten colour-coded units composed of sets, answers, checkouts and checkout answers. Show them examples from one of the units.

"While you are working on these units the class will be divided in half. Both halves will be working in a different way, though all of you will also be assigned to a small group or cluster of about four people.

I need to talk to both halves of the class separately. Will the children whose names I call out now please come up and set on the mat [or whatever you usually say]. The others can carry on doing their work [or reading a book, etc.]."

Now explain to the competitive group that the idea is to try and get a higher checkout score than other members of their small group or cluster. This means that they have to work as quickly and as accurately as they can. Show the scoring card. Explain how they fill it in (refer to p.%). Those in first or second place at the end of the lesson will receive a star by their name. Ask them to do as much of their work as they can on their own. They can ask the teacher for help if this is really necessary.

Assign the children in the competitive condition to their clusters and ask them to go back to their usual seats.

When you speak to the cooperative group, explain that they are to work on their own maths units but that they must help other members of their small group or cluster if they ask for help. If they have any difficulty in understanding their worksheets they must ask someone else in their own cluster for help. They are to obtain assistance from the teacher only if:

a) no-one in their cluster can help.

b) they have scored less than $^{8}/_{10}$ on their checkouts.

c) the teacher offers to give a short lesson to children doing the same work.

The idea is to try and help their cluster earn a high score for the day. They can do this by working quickly and accurately. Show the scoring card and explain how it is used (refer to p.8). Explain that each child in a particular cluster will be rewarded with a star if everyone in the group has done well. Refer to notes on setting the criterion and allocation of stars (p.8). Emphasize that it is most important that each child try as hard as he/she can.

Assign the children in the cooperative condition to their clusters and send them back to their usual seats.

Now proceed with the following steps:

(1) Give out individual envelopes with the children's names on and with the colour of the unit they will be starting on underlined.

(2) Show the children how to fill in the chart on the front of their envelope (which shows how many sets they have completed).

(3) Explain the use of the maths materials and practise with them. Tell the children that the work in their envelopes will be checked regularly.

(4) Describe the purpose of the conference chart.

(5) Nominate monitors for the distribution of materials.

(8) <u>Objectives and teaching notes for multiplication units</u>

Please refer to the steps outlined on the plan compiled by Eleanor Burt and adapted by Barry Brooker for a brief description of concepts to be covered in each unit.

Each page of the materials used in the individualized multiplication programme has a reference book and page number written on it. Please use these to refer to the teachers' handbooks as needed e.g. SM2, SM3, etc.

(9) Teaching Sessions

If a number of children from either condition need explanation or clarification of the same concepts they can be brought together for a 5-10 minute session with the teacher.

Please mark the names of children who have been helped in this way on the class list provided.

(10) Mathematics Post-test and Questionnaires

Instructions for administration will be provided later on.

Thank you for your willingness to participate in this cross-cultural research on the effects of cooperative and competitive learning methods.

These notes will need to be reread several times and referred to regularly during the initial process of familiarization with the methods to be used.

Please feel free to contact me whenever you have any questions or problems with the procedure. I will be making frequent brief visits to your classroom to help establish procedures. However, I encourage you to ring me any time at:

UNIVERSITY ph.
ext.
or HOME ph.

Krystyna M. Rzoska

APPENDIX 5

General Instructions for Administering the Student's Perception of Ability Scale, The School Attitude Survey, the Sociometric Measure and the Maths Post-test

Date of administration: Please administer the above test and questionnaires immediately after the completion of the individualized maths units before any other maths is taught. It is **very important** that the children do not learn any more maths until they have completed all the questionnaires and the Maths Post-test.

Absentees: Please write the names of children who are absent on the form provided (Details of Test Administration). These children will need to be tested as soon as they return to school (unless they are absent for more than two days). If you have any problems with providing quiet supervision for these children, please contact me.

Time of Administration: Please administer the test and questionnaires on a day that is as normal as possible, not before or after any exciting event. Choose the time of day when you know the children in your class concentrate the best. It is not advisable to administer two long questionnaires one after the other without a break, as tiredness could seriously affect the responses the children make.

Order of Test and Questionnaires: Please administer the Maths Post-test **LAST** so that the children's performance on this will not influence their responses on the questionnaires. The questionnaires and sociometric measure may be administered in any order.

Duration of Test and Questionnaires: As you will need to read out the items of the questionnaires to the children, you can adjust the speed according to the capability of your class. However, it is **most important** that the children have all the time they need to complete the Maths Post-test.

Confidentiality:

Research has shown that responses to questionnaires such as the ones you will be administering to your children can be easily influenced by the environment created by the administrator. If the children think there is any chance at all of you, their class

teacher, seeing their responses, their responses may be biased in a socially desirable direction. Therefore to assure the children of the confidentiality and anonymity of responses

1) point out that their questionnaires will be identified only by a code number.

2) tell the children beforehand that a member of their class will collect the questionnaires and place them into an envelope, which will then be sealed before their eyes.

3) Emphasize, before the children begin, that you will not be reading their responses. Tell the children that the questionnaires will all be given to me, and that because they have only a code number, I will not know who they belong to.

4) Please do not move around the room during the administration of the questionnaires (though this may be necessary during the Maths Post-test) as children may be afraid you will see their responses.

Preparation:

1) Seating - Please make sure that the children are seated in such a way that they are unable to see each other's answers.

2) Notice on classroom door - Please hang up a notice outside, such as - Do not Disturb - testing in progress.

3) Work for children who finish early (Maths Post-test only) - The children will need to have a book, project, etc. on their desk to go on with after they have completed the test. Please ask the children to turn their test paper upside down on their desks when they have finished.

4) Materials - For the maths test and questionnaires the children will need a dark pencil and a rubber (also scrap paper for working out answers to the maths test).

N.B. Code Numbers: The maths test, sociometric measure and questionnaires will all have written on them each child's particular code number. **IT IS ESSENTIAL THAT EACH CHILD RECEIVES A QUESTIONNAIRE OR TEST WITH HIS/HER OWN CODE NUMBER WRITTEN ON IT.** A class list with children's code numbers next to their names will be provided. Please ensure that each test or questionnaire a

child receives has the same code number on it as that written by his/her name on the class list.

If any children write their responses on a questionnaire or test with someone else's code number on it by mistake, it will be impossible to identify which condition (cooperative or competitive) they belong to or to compare the post-test results with that of the pre-test. Therefore if any mistakes are made in handing out the measuring instruments the whole study WILL HAVE BEEN A WASTE OF TIME.

General Points

1) As attitude surveys are sensitive to the effects of time of day, or day of the week, it is generally best to avoid the first and last days of the week and the last class hour of the school day.

2) Teachers - please do not fill in the boxes on the right hand side of the forms. These are for computer coding.

3) Data from the questionnaires will be reported only as averages for large groups taken from the entire experimental sample. Scores for individuals or separate schools will not be known.

Specific Administration Instructions

Student's Perception of Ability Scale

1) Follow general instructions for administration first.

2) Then tell the children that this is a questionnaire "designed to find out about their feelings and attitudes towards school and their school work". Mention that Mrs Rzoska needs this information for the research she is doing. Emphasize that the questionnaire is not a test and that therefore there are no "right" or "wrong" answers. Their questionnaire will be identified only by a code number.

3) Read out the directions to the children and make sure they are clear about what to do.

4) Read each item aloud to the pupils (at the rate of about three per minute).

5) Before turning to the next page ask all pupils to check that no questions have been missed, and that they have not responded with both "YES" and "NO" to any one question. They should also be reminded to make sure that they have clearly erased any changed responses.

6) Refer to general administration instructions for collection of questionnaires.

School Attitude Survey. (Instructions adapted from those in the MSAS Manual (Ahlgren, 1983)

1) Follow general administration instructions first. Please take special notice of the section on confidentiality and anonymity. Before you start, appoint a child (children) to collect the surveys.

2) Read the items in a lively but neutral tone of voice so that all items will be clearly heard and receive equal emphasis.

3) If during the administration, some pupils seem unsure about what is meant by a particular item, feel free to explain, using simple language (but without influencing the children in any particular direction).

4) Explain to the children - "Mrs Rzoska would like you to fill in this questionnaire to help her with the research (study) she is doing. She wants to find out how children feel about what they do in school. This is not like a test. There are no right or wrong answers.

5) Distribute the questionnaires making sure each child has the correct code number.

Does everyone have a pencil? Does everyone have a questionnaire? We *don't* want you to put your name on the paper. I'm not even going to *see* your paper after you mark it. When you're finished, the papers will be put in an envelope and given to Mrs Rzoska. Then your answers will be read by a computer along with everybody else's. Just answer honestly, and please answer every question you can.

[For years 4-6] We know that probably all of you can read these questions, but some of you can read faster than others. To keep you all moving along together, I'll read the questions aloud to you.

If a student will be collecting the completed survey forms, explain that procedure now.

PART ONE

When the students are ready, continue.

Now let's look at the first page of the survey form. Here's [point] a sample that shows what the questions are like, and we'll practice with it. Find the sample question on your paper and point to it. At the top of the box, it says,

Watching TV at home. We want you to show how you feel about watching TV at home.

If you feel *happy* when you think of watching TV at home, fill in the nose of the *smiling* face.
[Demonstrate]

If you feel *sad*, or *afraid*, or *mad* when you think about watching TV at home, fill in the nose of the *unhappy* face.
[Demonstrate]

Or, if you aren't sure *how* you feel about watching TV at home, mark the nose of the middle face.
[Demonstrate]

Fill in all of the nose, but don't go outside it. Now mark how you feel.

[For young children, continue by saying:] I want to see if everybody makes a good, dark nose.

Remember, your answers can't be wrong, because we want to know what *your* feelings are - not what your teacher thinks, or your friends, or anybody else. If you don't understand a question, raise your hand and I'll explain it to you. If a question makes no sense at *all* to you, you can just leave it blank. All right, now let's start.

Hold up a survey form and point to box 1.

I'm pointing to the first box, the one with a 1 in the corner. Find that box on your sheet, and put your finger on it, so I can see if you have the right place.

Move around the room to check the students' papers. Then return to the front of the room before the children write their answers.

In box 1, it says *Learning Maths*. Fill in the nose on the face that shows how *you feel* about learning maths.

Next to that is box 2, with a 2 in the corner, and it says, *Learning to read better*. Mark the nose on the face that shows how you feel about learning to read better.

Continue in this way until you get to the bottom of the page.

Now we are at the bottom of the first page. Turn the page. There are more boxes and faces. We'll go through them

together. At the top is box 17. Put your finger on box 17.

Check to be sure students are in the right place on the page.

Box 17 - *Doing tests.*
Mark how you feel about doing tests.

Continue in this way.

PART TWO

When the students are ready, continue.

All right, now you can rest for a bit while I tell you how to answer another type of question.

look at the box written under the heading Part Two.

In this box it says, *I like to get up early.* If you *do* like to get up early in the morning, then you should mark the first circle, above where it says, True. If you *don't* like to get up early in the morning, mark the circle at the other end, above where it says, False. "False" means "not true". Or, maybe you think it's a *little* true-you sort of like to get up early. Then you mark the second circle on the true side, *next* to the end. Or maybe you think it's a *little* false - you sort of *don't* like to get up early. Then you mark the circle *next* to the end on the false side. Mark how true or false you think it is for you, [point to each circle] true, a little true, a little false, false. Are there any questions?

Answer any questions, and make sure that students understand what they are to do.

Now let's start. Box 1 is under the sample question.
Point to Box 1.

Box 1 says, *I have to hurry to finish my work in class.*
Mark how true or false that is for you. Are there any questions?

Answer any questions, and then continue.

Box 2 says, *My teachers care about how much I learn.*
Mark how true or false you feel that is.

Box 3, *My teachers like me the way I am.* Mark that one.

Box 4 says, *I like to have other children help me learn.* Mark how you feel about that.

Continue in this way until the question at the bottom of the page.

Here's the last one on this page. No. 14 - *I like to do better work than my friends.* How true is that for you? Mark your answer.

You can have a little rest now. [Pause]. Now turn to the last page. Point to number 15. [Check to make sure all pupils are pointing to item 15].

Number 15 says *My teachers like to help me learn.* Mark how true or false that is for you.

Continue in this way until finished.

We've finished the questionnaire now. You did a good job.

Follow the suggested procedure for collecting the questionnaires, being careful not to look at any of them.

Sociometric Measure

Please seat the children so that they will not be able to see what their neighbours are writing.

Hand out the sociometric measure, making sure that each child has the correct code number.

Then begin as follows -

> "As part of her study Mrs Rzoska would like to learn about the friends children make.
>
> On the piece of paper you have been given there are two columns. Point to the first column. In the first column you are to tick the names of SIX (only six) children you would like to sit next to in class. Tick these now. Point to the second column. In this column you are to tick the names of SIX (only six) children you would like to be your best friends. Tick them now"

When the children have finished, ask them to count that there are six ticks in each column (twelve ticks altogether).

Collect the papers.

Mathematics Post-Test

Please administer this test last (but not when the children are tired).

Follow the general administration instructions first.

Specific instructions

Please make sure that all the children are handed a test with the correct code number. Then read the following instructions.

Instructions for children

This is a test to see how you have improved in mathematics. You have as long as you need to complete the test. Please write your answers clearly on the test form. Do not write in the little boxes on the side. Do all your working out on scrap paper.

Please answer as many questions as you can. You must do your own work. I will not be able to help you. If you can't understand a question, leave it and go on to the next one.

When you have finished, check your answers, turn your paper upside down on your desk and quietly read the book (or do your project, etc.). Do not leave your desk.

Are there any questions?

Turn your paper over and write your name on the paper.

Turn over the page and begin the test.

After the test:

1) Collect the test papers and put into the envelope provided.

2) Fill in the form on the front of the envelope.

Marking:

If you have time, it would be of great help to me if you could once again mark your class's tests. (Please do not write in the boxes on the right hand side of the pages.) You may be interested to see how the scores compare with those of the pre-test. If you are too busy, I will mark the tests myself.

APPENDIX 6

The ten steps of the cyclic approach to multiplication (Eleanor Burt)

Step 1 ORANGE	Step 2 OLIVE	Step 3 BLUE	Step 4 BROWN	Step 5 GREEN	Step 6 RED
Products upto 45 Introduce x x 2 upto 9x2 lots of, sets of Show 3x2 = 2+2+2 Show 3x2 = 2x3 x 5 upto 9x5 Understand meaning of x Show effect of x1 Show order of factor does not affect the product x 3 upto 9x3 Record 9x3= 9 Show effect of x0 x13 x3 Show sets on a numberline 91 x4 upto 9x4 Name factor, product Show mult, addition are related	Products upto 81 Build Table Array (Small Group Interviews) Show factor, product Understand meaning of x Show order of factors does not affect the product Show effect of x1 Show effect of x0 Study basic facts to 45 Solve word problems at this level.	2 digit by 1 digit no renaming → →	2 digit by 1 digit with renaming Introduce multiples Explore the roles of mult & add. in type 3x17 = 3x(10+7) =(3x10)+(3x7) → →	3 digit by 1 digit Commit basic facts to 45 to memory →	Multiply by 10 (20, 30) Study basic facts to 81 →

Step 7 TAN	Step 8 GOLD	Step 9 AQUA	Step 10 PURPLE	Form 1 and 2.
2 digit by 2 digit Show how grouping and regrouping does not affect the product	3 digit by 2 digit Commit basic facts to 81 to memory	Multiply by 100 (200, 300) Maintain mastery and increase speed of recall	Solve type 27·64 x 5	Use calculator for multiplying whole numbers. Multiply by 1000 Solve type 1·4 x 2·8 Multiply 2 place decimals by 10, 100, 1000 Solve type 2·34 x 5·6 Use calculator for above Find fraction of whole number Estimate product with 3 digit multipliers Multiply by powers of 10 Check product by using inverse operation.

Estimate product and compare with worked result
Solve word problems at this level
Apply multiplication to practical measuring and money
Become familiar with the use of a calculator

APPENDIX 7

MANOVA Summary Data for the Mathematics Achievement Test (complete test)

SOURCE OF VARIATION	DF	F	SIG. OF F.
MAIN EFFECTS			
TEST	1	108.51	.000
2-WAY INTERACTIONS			
CONDITION × TEST	1	.58	.45
ETHNICITY × TEST	2	1.32	.27
3 WAY INTERACTIONS			
CONDITION ETHNICITY TEST	2	.69	.50

MANOVA Summary Data for the Mathematics Achievement Test (Algorithms)

SOURCE OF VARIATION	DF	F	SIG. OF F.
MAIN EFFECTS			
TEST	1	84.86	.000
2-WAY INTERACTIONS			
CONDITION × TEST	1	.99	.32
ETHNICITY × TEST	2	.68	.51
3 WAY INTERACTIONS			
CONDITION ETHNICITY TEST	2	.63	.53

MANOVA Summary Data for the Mathematics Achievement Test (Word Problems)

SOURCE OF VARIATION	DF	F	SIG. OF F.
MAIN EFFECTS			
TEST	1	77.91	.000
2-WAY INTERACTIONS			
CONDITION × TEST	1	.00	.98
ETHNICITY × TEST	2	2.95	.05
3 WAY INTERACTIONS			
CONDITION ETHNICITY TEST	2	.42	.66

ANOVA Summary Data for the School Attitude Survey (Full Scale)

SOURCE OF VARIATION	DF	F	SIG. OF F.
MAIN EFFECTS			
CONDITION	1	2.77	.10
ETHNICITY	2	.99	.37
2-WAY INTERACTIONS			
CONDITION ETHNICITY	2	1.69	.19

ANOVA Summary Data for the School Attitude Survey

(Competitive Scale)

SOURCE OF VARIATION	DF	F	SIG. OF F.
MAIN EFFECTS			
CONDITION	1	.13	.72
ETHNICITY	2	.23	.79
2-WAY INTERACTIONS			
CONDITION ETHNICITY	2	.42	.66

ANOVA Summary Data for the School Attitude Survey

(Cooperative Scale)

SOURCE OF VARIATION	DF	F	SIG. OF F.
MAIN EFFECTS			
CONDITION	1	1.14	.29
ETHNICITY	2	5.97	.003
2-WAY INTERACTIONS			
CONDITION ETHNICITY	2	.09	.91

ANOVA Summary Data for the Students' Perception of Ability Scale (Full Scale)

SOURCE OF VARIATION	DF	F	SIG. OF F.
MAIN EFFECTS			
CONDITION	1	.01	.93
ETHNICITY	2	2.17	.12
2-WAY INTERACTIONS			
CONDITION ETHNICITY	2	.15	.86

ANOVA Summary Data for the Students' Perception of Ability Scale (General Ability)

SOURCE OF VARIATION	DF	F	SIG. OF F.
MAIN EFFECTS			
CONDITION	1	.00	.99
ETHNICITY	2	2.27	.11
2-WAY INTERACTIONS			
CONDITION ETHNICITY	2	1.04	.36

ANOVA Summary Data for the Students' Perception of Ability Scale (Arithmetic)

SOURCE OF VARIATION	DF	F	SIG. OF F.
MAIN EFFECTS			
CONDITION	1	.10	.76
ETHNICITY	2	.46	.64
2-WAY INTERACTIONS			
CONDITION ETHNICITY	2	.10	.91

ANOVA Summary Data for the Students' Perception of Ability Scale (School Satisfaction)

SOURCE OF VARIATION	DF	F	SIG. OF F.
MAIN EFFECTS			
CONDITION	1	.42	.52
ETHNICITY	2	9.67	.001
2-WAY INTERACTIONS			
CONDITION ETHNICITY	2	.66	.52

ANOVA Summary Data for the Students' Perception of Ability Scale (Reading/Spelling)

SOURCE OF VARIATION	DF	F	SIG. OF F.
MAIN EFFECTS			
CONDITION	1	.29	.59
ETHNICITY	2	.80	45
2-WAY INTERACTIONS			
CONDITION ETHNICITY	2	.81	.45

ANOVA Summary Data for the Students' Perception of Ability Scale (Penmanship/Neatness)

SOURCE OF VARIATION	DF	F	SIG. OF F.
MAIN EFFECTS			
CONDITION	1	.19	.66
ETHNICITY	2	3.71	03
2-WAY INTERACTIONS			
CONDITION ETHNICITY	2	.00	1.00

ANOVA Summary Data for the Students' Perception of Ability Scale (Confidence)

SOURCE OF VARIATION	DF	F	SIG. OF F.
MAIN EFFECTS			
CONDITION	1	.13	.72
ETHNICITY	2	3.08	05
2-WAY INTERACTIONS			
CONDITION ETHNICITY	2	2.25	.11

APPENDIX 8

Mean Scores for the Algorithm Items of the Mathematics Achievement Test by Condition and Ethnic Group

Condition and Ethnic Group	Pre-Test	Post-Test
Competitive		
Maori (N=32)	9.81	11.66
Pakeha (N=92)	9.46	11.64
Samoan (N=22)	8.59	10.82
Total Sample (N=146)	9.29	11.37
Cooperative		
Maori (N=36)	8.78	11.11
Pakeha (N=102)	10.23	12.27
Samoan (N=23)	8.35	11.74
Total Sample (N=161)	9.12	11.71

APPENDIX 9

Mean Scores for the Word Problem Items of the Mathematics Achievement Test by Condition and Ethnic Group

Condition and Ethnic Group	Pre-Test	Post-Test
Competitive		
Maori (N=32)	2.31	3.59
Pakeha (N=92)	2.62	3.45
Samoan (N=22)	2.18	3.32
Total Sample (N=146)	2.37	3.45
Cooperative		
Maori (N=36)	2.44	3.56
Pakeha (N=102)	3.01	3.65
Samoan (N=23)	2.17	3.65
Total Sample (N=161)	2.54	3.62